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ATARI®



Operation, Maintenance and Service Manual

A Warner Communications Company

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STARSHIP 1™

Operation, Maintenance and Service Manual

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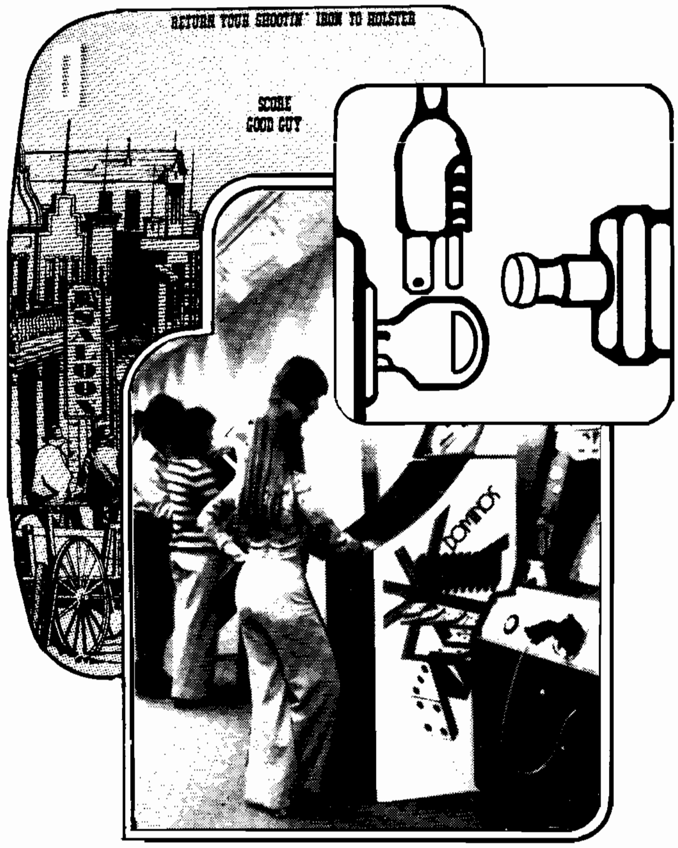
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LOCATION SETUP

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A. INTRODUCTION

Atari's Starship 1™ is a futuristic one-player computer-controlled game that simulates space flight. The object of the game is to destroy alien spacecraft while maneuvering through star and asteroid fields. A player's score is determined by the number of alien spacecraft destroyed.

You, the owner of Starship 1, have options available in the game. The options are for the number of coins necessary to play the game and whether or not extended play is awarded. These options are selected by removing the game printed circuit board from the metal RF box and setting switches as desired.

Starship 1, like all recent Atari video games, has a self-test function that tests approximately 75% of the game's circuitry. By energizing the Self-Test function, you can determine if the game *is* or *is not* operating properly.

B. GAME INSPECTION

Your new Starship 1 is manufactured by Atari with the intent of being ready to play right out of the shipping carton. However since we cannot be sure that the shipper delivered Starship 1 to you in one piece, we need your cooperation in supplying the last touch of quality control. Therefore, we at Atari would appreciate your following the procedures below to ensure that you are getting the quality of game that you expect from Atari.

1. Examine the external parts of the game cabinet for dents, chips, or broken parts. If you have purchased this game as a new unit, make sure that it looks new.

2. Unlock and open the rear access door. Examine the inside of the game cabinet for anything that appears broken or out of place.

C. INSTALLATION REQUIREMENTS

All special requirements for the installation of the game are listed as follows:

Power Requirements:

Atari ships Starship 1 for the domestic operation on 110 VAC, rated at approximately 150 watts. The game can be changed to operate at 95 VAC by unplugging the Molex connector plug (see Figure 1 for location of plug) with orange wires (110 VAC) and plugging in the Molex connector plug with black wires (95 VAC).

For those operating the game on 220 VAC (50 Hz), use the Molex connector plug that has red wires. For a location voltage that is less than 210 VAC use the Molex connector plug with green wires (205 VAC).

Temperature Range:

Location and storage temperature ranges should be no lower than zero degrees Celsius (32 degrees Fahrenheit) to no higher than 49 degrees Celsius (120 degrees Fahrenheit).

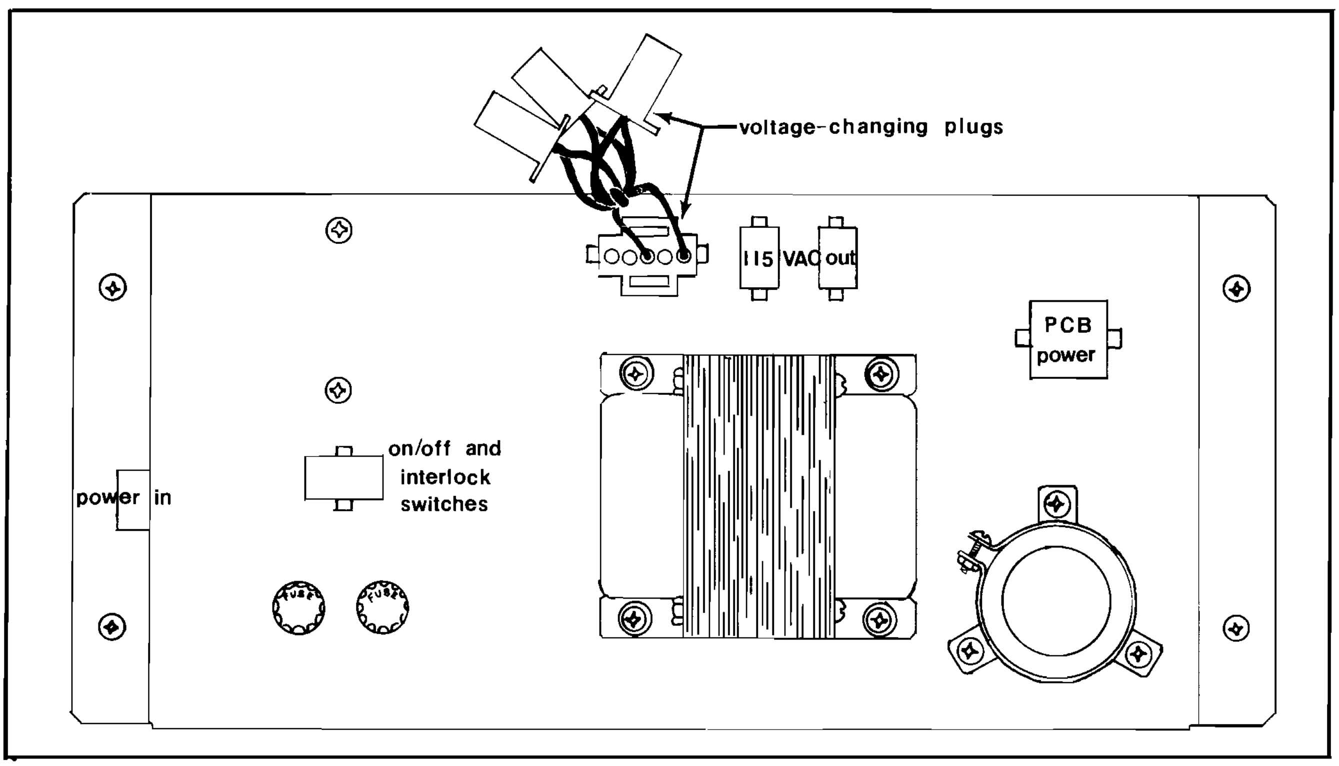


Figure 1 Location of Voltage-Changing Plugs

Humidity Range:

Location and storage relative humidity should be no more than 95%.

Location Space Required:

Starship 1 requires a minimum of 185 centimeters (73 inches) of vertical clearance, a minimum of 75 centimeters (29.5 inches) of width clearance, and 152 centimeters (60 inches) of depth clearance. Depth clearance includes 61 centimeters (24 inches) of minimum player space.

Length and Type of Power Cord:

Atari has added a 1.83-meter (six-foot) strain relief power cord to Starship 1. The advantage of the strain relief cord is that if someone trips over the cord, the cord will break off just inside the game cabinet. Tripping over a non-strain relief cord may result in ripping out the insides of a game.

D. INTERLOCK AND POWER ON/OFF SWITCHES

Atari had two concerns that resulted in our installing two on/off switches, as illustrated in Figure 2. The first concern was to minimize the hazard of electrical shock while you are working inside the game cabinet. Therefore, we installed an interlock switch on the rear access door frame that completely removes power from the game when the access door is open.

Our second concern was energy conservation. A power on/off switch has been added to Starship 1 so that the game can be turned off during low business periods and closing hours. This switch is conveniently hidden on the right side of the top panel, near the rear of the game cabinet.

Please check for the proper operation of the rear access interlock switch by performing the following:

1. Unlock and open the rear access door.
2. Plug the AC power cord into a 110-volt source. (If the voltage is less than 100 VAC, make sure that the voltage plug is changed to the black plug.)
3. Set the power on/off switch to the *on* position by flipping the toggle switch toward the front of the game cabinet.
4. Close the rear access door. Within approximately thirty seconds the TV monitor should display a picture.
5. Slowly open the rear access door until the TV monitor picture disappears. The TV monitor picture should disappear when the rear access door is opened to less than one-inch at the top of the door.
6. Close and lock the rear access door. If the results of Step 5 are OK, then the interlock switch is operating properly. If not OK, check to see if the switch is broken from its mounting or stuck in the *on* position.

E. SELF-TEST PROCEDURE IN TABLE 1

Starship 1 will test itself and provide data to communicate with you that the game's circuitry and controls are working properly. We suggest that you do the Starship 1 Self-Test Procedure each time you empty the coins from the game's cash box.

There are three tests performed with the self-test switch on. The first test is done completely by the Starship 1 computer. In this test, the computer determines if its memory is OK. In the second test, you activate each switch to determine if they are operating properly. In the third test, you move the control yoke to determine if it is operating properly.

The fourth test is performed with the self-test switch in the *off* position. In this test you determine if the coin acceptors are operating properly.

Perform the Self-Test by following the instructions of Table 1.

F. OPERATOR OPTIONS IN TABLE 2

At this time, decide what options are best suited for your location of the Starship 1 game. The coinage options on Starship 1 are 2 games per coin, 1 game per coin, or 2 coins per game. Starship also has a time option ranging from a one-minute to a one-and-one-half-minute game.

Set the options of the game as described in Table 2. Refer to Figure 3 for the location of the option controls.

If you decide to have a bonus time option, install the BONUS TIME player notice (comes in poly bag with new game) on the bezel immediately inside the game cabinet above the player controls. Refer to Chapter 3 for instructions for the removal of the front housing assembly.

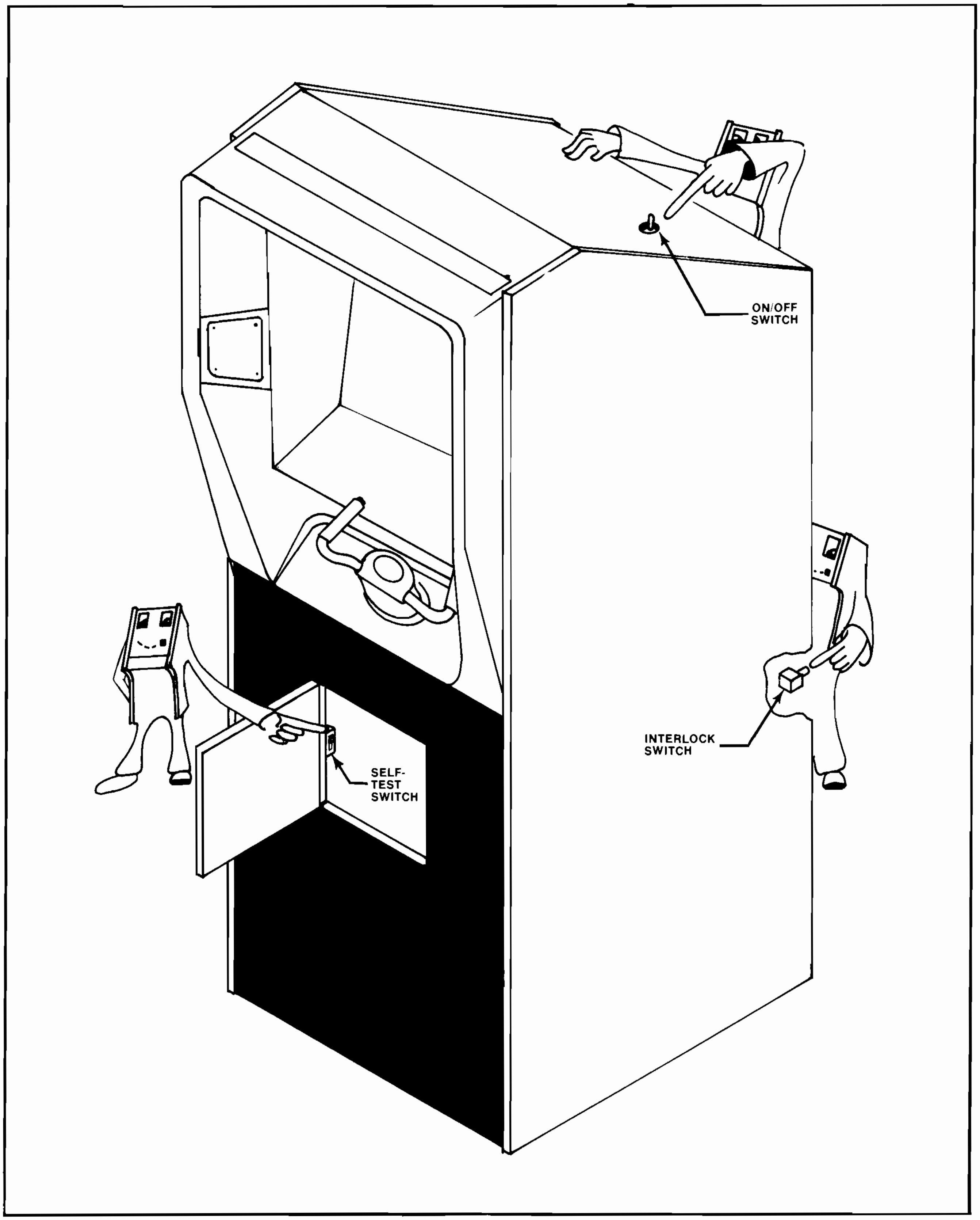


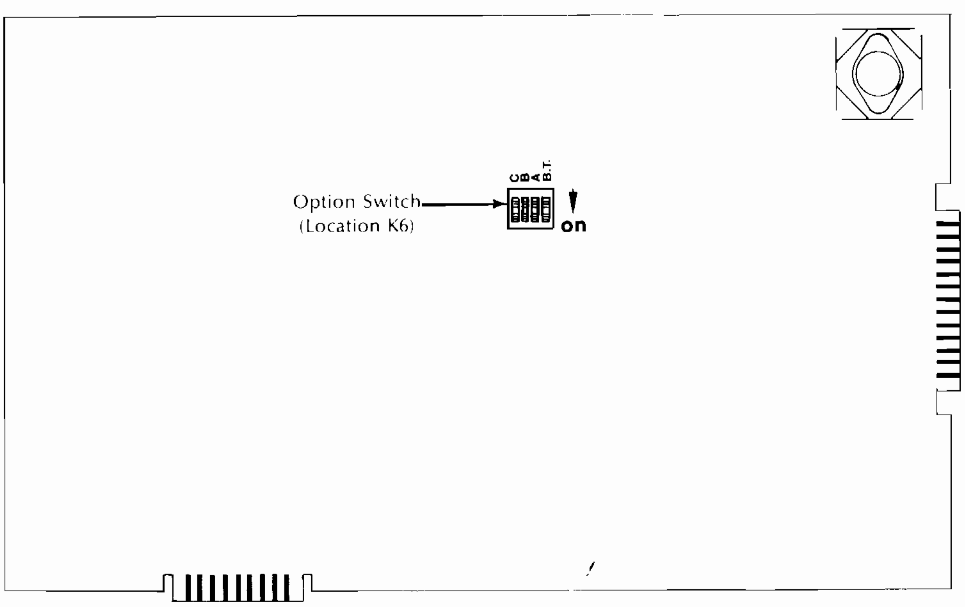
Figure 2 Location of Power On/Off and Interlock Switches

Table 1 Starship 1™ Self-Test Procedure

Test	Instruction	Results if Test Passes	Results if Test Fails
1	Unlock and open Coin Door. Set Self-Test slide switch (located inside and to the left of the Coin Door) to the *on* position.	TV monitor displays almost anything that is normal for the attract or play mode. *Test tone is always present from both speakers during Self-Test 1.*	TV monitor displays the words BAD ROM followed by a number.
	If test fails, record the BAD ROM number, shut off the game, call your distributor and tell him the ROM failure number.		
	Note to Distributors: BAD ROM 0 indicates a failure of PROM 1 (location C/D1) or PROM 2 (Location C/D2).		
	BAD ROM 1 or BAD ROM 2 indicates failure of ROM B (location E3).		
	BAD ROM 3 or BAD ROM 4 indicates failure of ROM A (location H3).		
2	Press START pushbutton.	Test tone volume increases.	Test tone remains the same.
	Press PROTON TORPEDOS pushbutton.	Test tone volume increases.	Test tone remains the same.
	Set THRUST CONTROL to SLOW.	Test tone frequency is lower than when control is in FAST position.	Test tone remains the same.
	SET THRUST CONTROL to FAST.	Test tone frequency is higher than when control is in SLOW position.	Test tone remains the same.
3	Turn control yoke to left and down, then turn to right.	Test tone frequency increases as control yoke is turned from left to right.	Test tone remains the same.
	Pull control yoke up.	Test tone frequency increases as control yoke is moved from downward position to upward position.	Test tone remains the same.
4	Set Self-Test slide switch to *off* position. Trip and hold in the tripped position each of the coin mechanism trip wires.	TV monitor displays the word COIN as long as one of the coin mechanisms trip wires is held in the tripped position.	No change in the TV monitor.

Table 2 Option Switch Settings

Option	Option Switch Settings			
	C	B	A	BT
2 Plays Per Coin	OFF	ON	ON	
1 Play Per Coin	ON	OFF	ON	
2 Coins Per Play	ON	ON	OFF	
No Bonus Time				OFF
Bonus Time				ON



NOTE

There are six potentiometers on the Starship 1 Game PCB. Ensure that you know which potentiometer you are adjusting. Adjusting the incorrect potentiometer may cost you money.

G. VOLUME CONTROL

If volume is incorrect for your location, remove the game PCB and adjust the volume to your desire. See Figure 3 for the location of volume control.

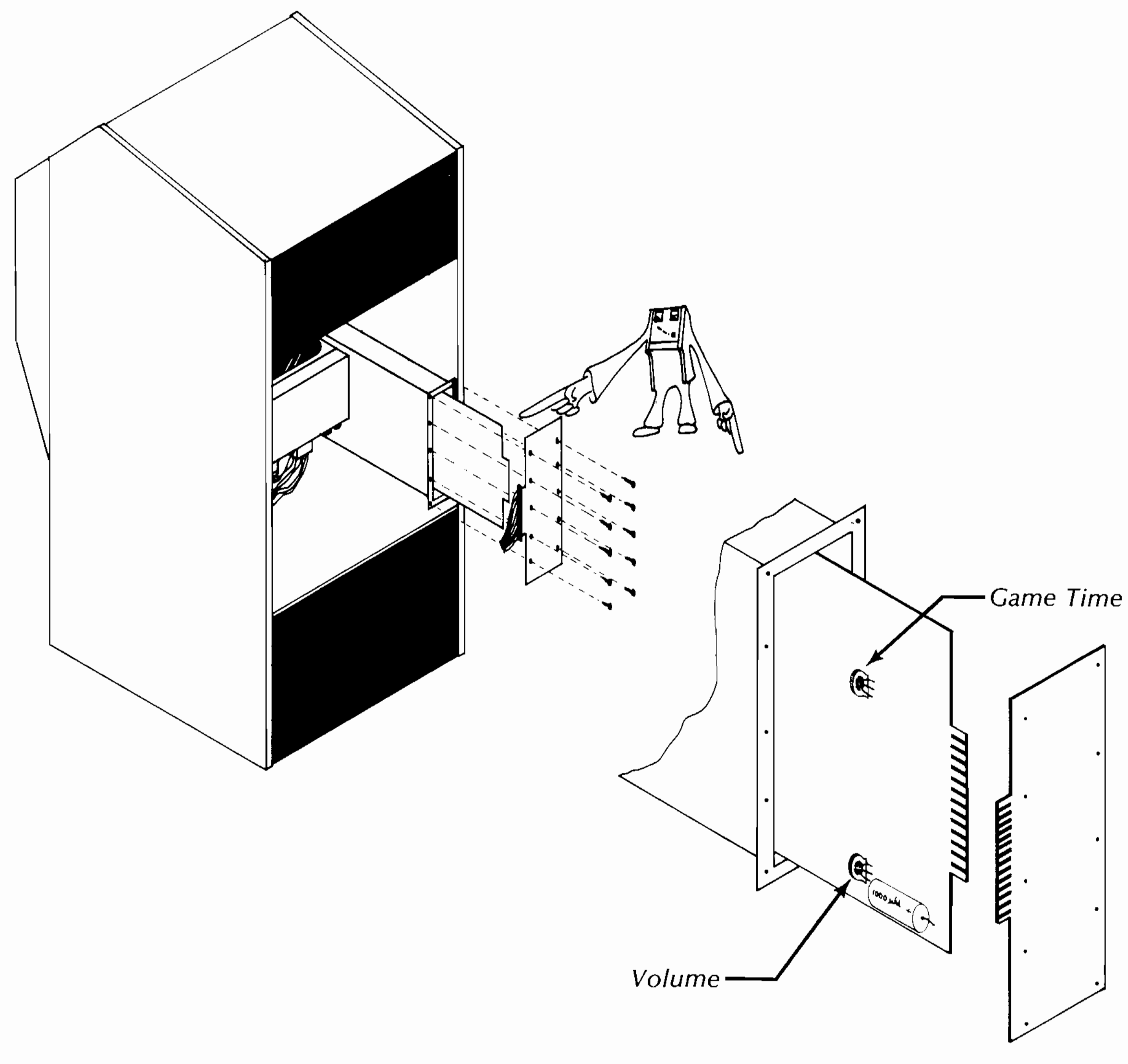


Figure 3 Location of Game Time and Volume Adjustments



GAME PLAY

2

During game play, Starship 1 can be described as operating in any of three modes: attract, ready-to-play or play mode.

A. ATTRACT MODE

The attract mode begins with the application of power and ends when the proper amount of coins are accepted. During the mode, the T.V. monitor displays four one-line messages. The first line indicates the last player's score and number of crashes. The second line appraises the previous game performance (for example, YOU HAVE SAVED THE FEDERATION or YOU HAVE LOST EVERYTHING). The third and fourth lines are an instruction for the player to deposit a coin to be in command of Starship 1.

Throughout this mode, all controls are inactive.

B. READY-TO-PLAY MODE

This mode begins when the proper number of coins are accepted and ends when the START button is pressed.

During this mode, the TV monitor displays the following message:

YOU ARE IN COMMAND
PRESS START FOR NEXT MISSION

Throughout this mode, all player controls are inactive.

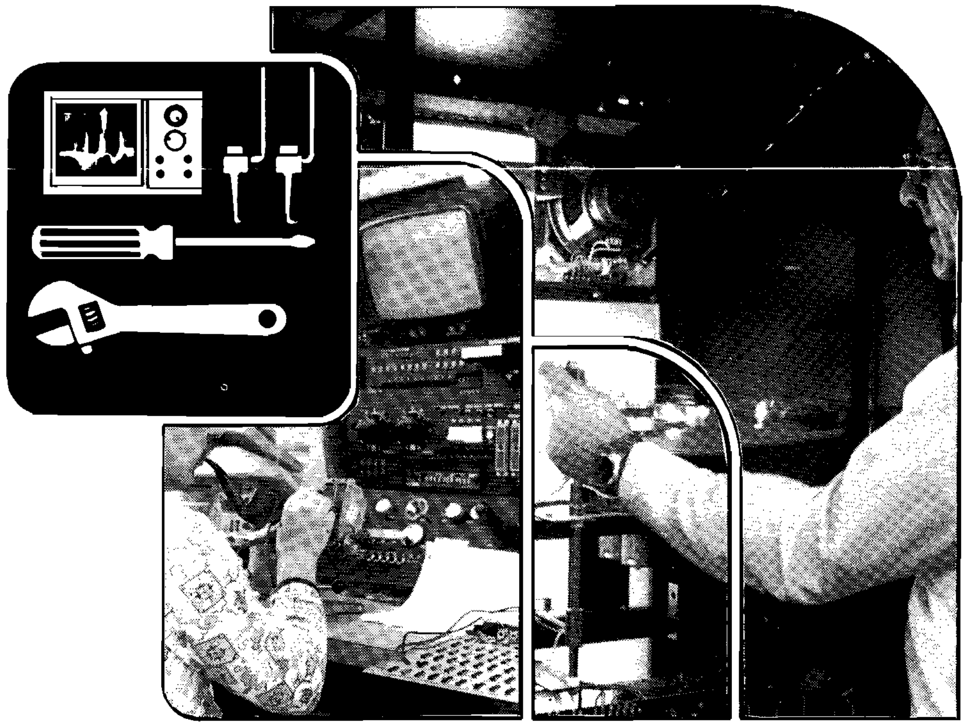
C. PLAY MODE

This mode begins with pressing the START pushbutton and ends when the game time runs out. Throughout this mode, all player controls are active.

The THRUST CONTROL sets the speed at which the displayed space objects move towards the player. This can be changed from SLOW to FAST or from FAST to SLOW anytime during the game mode.

The player has two ways of destroying alien spacecraft to earn game score points. One way is to line up an alien spacecraft in the laser sights (X mark on TV monitor screen) and then press one of the laser activator pushbuttons located on the end of each handle of the control yoke. The other way of destroying alien spacecraft is to press the PROTON TORPEDOS pushbutton. This results in destroying all alien spacecraft that are displayed on the TV monitor. This second method is obviously easier, but a player is limited to five proton torpedos per game.

The control yoke operates just like in an airplane. To operate the control, the player must imagine being in Starship 1 and flying toward the targets. To go up, the player must pull down on the control yoke. To go left, the player must turn the control yoke to the left.



MAINTENANCE AND ADJUSTMENTS

3

Due to its solid-state electronic circuitry, this Atari unit should require very little maintenance and only occasional adjustment. Information given in this chapter and elsewhere in the manual is intended to cover most servicing situations that may be encountered at the game site. The procedures given are in sufficient detail to be understood by a person with moderate technical ability.

NOTE

If reading through the manual does not lead to solving the specific maintenance problem, you can reach Atari's Customer Service Department by telephone (open Monday through Friday, 7:30 am to 4:30 pm Pacific Time):

from **outside** *California (800) 538-6892 (toll-free)*

from **inside** *California (408) 984-1900*

For those interested in gaining more information on video game technology, especially the electronics, we recommend reading the **Video Game Operator's Handbook,** *manual no. TM-043. This book is available from Atari, Inc., attn. Customer Service Dept., 2175 Martin Avenue, Santa Clara, CA 95050 for $5.00 each, or from your distributor.*

A. CLEANING

The exteriors of game cabinets and plex panels may be cleaned with any non-abrasive household cleaner. If desired, special coin machine cleaners that leave no residue can be obtained from distributors. Do *not* dry-wipe the plex panels because any dust on the surface can scratch the surface and results in fogging the plastic.

B. COIN MECHANISM

Components On Coin Door

Figure 4 shows the back side of the coin door assembly where the game's two coin mechanisms are mounted. Included is the lock-out coil assembly; the lock-out wires are connected to this assembly but are hidden behind the coin mechs. During the attract mode the microcomputer energizes the lock-out coil, causing the lock-out wires to retract far enough to allow genuine coins to reach the coin box. But during the ready-to-play mode when the LED is lighted and during the play mode (and also when AC power to the game has been turned off) the lock-out coil is de-energized, causing the lock-out wires to move out far enough to divert coins over to the return chute.

Directly below each coin mechanism is a secondary coin chute and a coin switch with a trip wire extending out to the front edge of the chute. When the trip wire is positioned correctly, a coin passing down the secondary chute and into the coin box will momentarily push the trip wire down and cause the switch contacts to close.

Also shown in the photograph is a slam switch assembly. It has been included to defeat any players who might try to obtain free game plays by violently pounding on the coin door to momentarily close the contacts on a coin switch. The slam switch contacts connect to the microcomputer system, which will ignore coin switch signals whenever the slam switch contacts are closed.

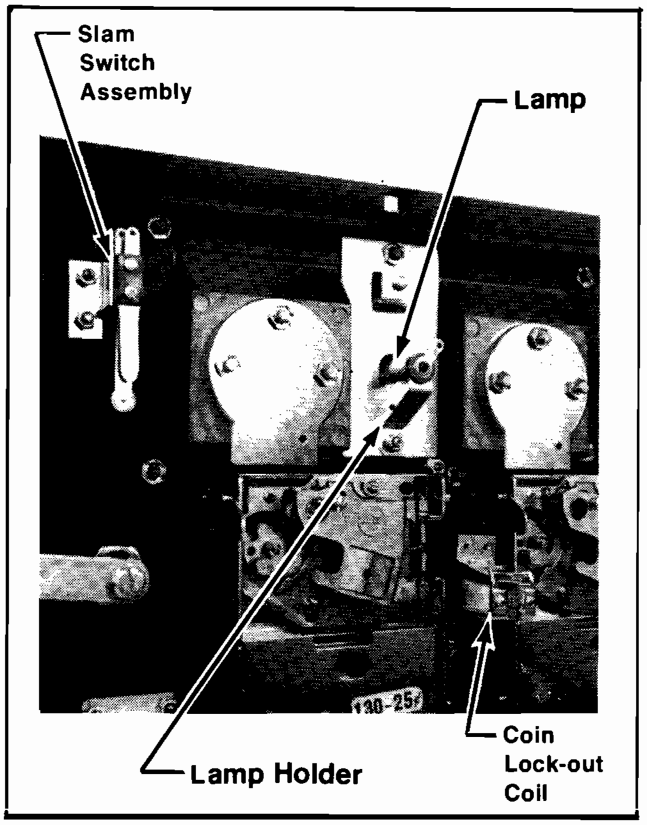


Figure 4 Coin Door Assembly

Access To Coin Mechanisms

To remove jammed coins, and for maintenance cleaning, each magnet gate assembly can be hinged open without removing it from the door, as shown in Figure 5. Or, if necessary, each coin mechanism can be entirely removed from the door merely by pushing



Figure 5 Hinging Open the Magnet Gate Assembly

down on a release lever and simultaneously tilting the mechanism back, then lifting it up and out. This is shown in Figure 6.

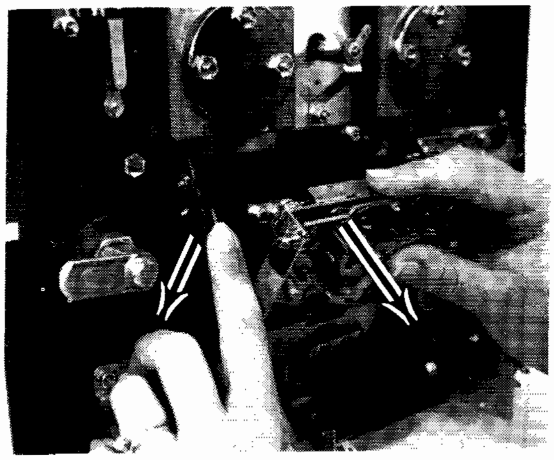
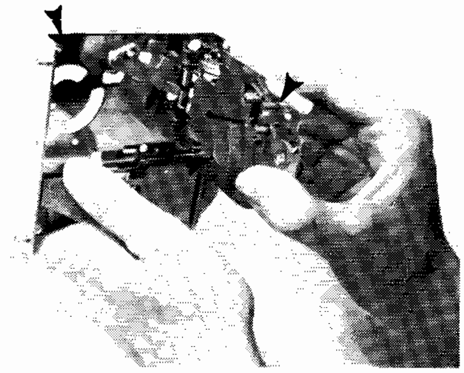


Figure 6 Removal of Coin Mechanism



(Clean both surfaces where coin enters the mechanism, as well as the magnet)

Figure 7 Surfaces to Clean Inside the Coin Mechanism

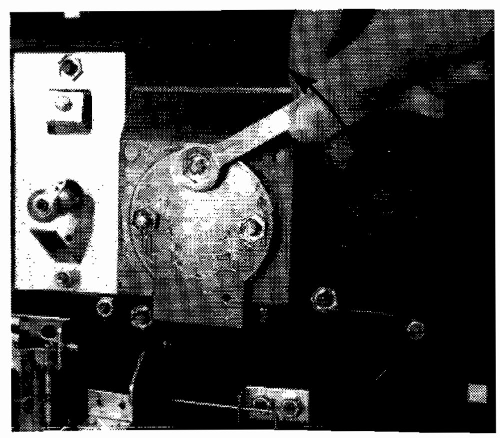


Figure 8 Removal of Plate Covering Rear of coin slot

Cleaning of Coin Paths

CAUTION

The use of an abrasive (such as steel wool or a wire brush) or a lubrication on a coin mechanism will result in a rapid build-up of residue.

By talking to many operators, we have found that the best method of cleaning a coin mechanism is by using hot or boiling water and a mild detergent. A toothbrush may be used for those stubborn buildups of residue. After cleaning, flush thoroughly with hot or boiling water, then blow out all water with compressed air.

Figure 7 shows the surfaces to clean inside the coin mechanism. These include the inside surface of the mainplate, and the corresponding surface of the gate assembly. There may also be metal particles clinging to the magnet itself. To remove these you can guide the point of a screwdriver or similar tool along the edge of the magnet.

If coins are not traveling as far as the coin mechanisms, you will need to clean the channel beneath the coin slot. To gain access to this channel, use a ⅜-inch wrench and remove all three nuts that secure the cover plate (refer to Figure 8). Removing the plate will provide access to the entire channel.

Also clean the inside surfaces of the secondary coin chutes, but when doing this be careful not to damage or bend the trip wires on the coin switches.

Lubrication. Do *not* apply lubrication to the coin mechanisms. The only points that may need lubrication (and only rarely) are the shafts of the scavenger buttons (coin rejection buttons) where they pass through the coin door. Apply only one drop of light machine oil, and be positive that no oil drops down onto a coin mechanism. Figure 9 shows this lubrication point.

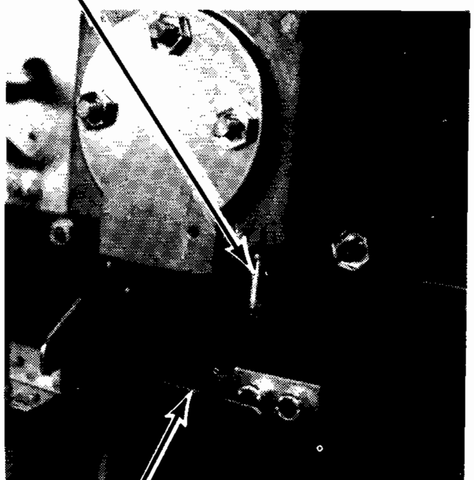


Figure 9 Close-up View of Lubrication Point

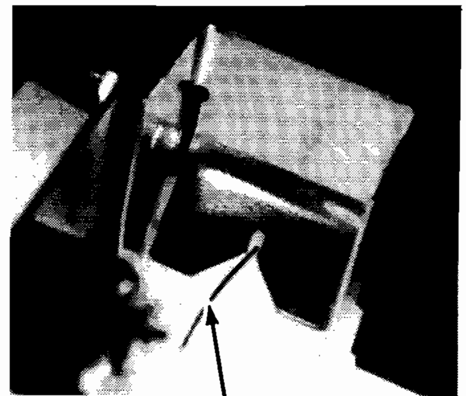


Figure 10 Detail View of Coin Switch and Trip Wire

Adjustment of Coin Switch Trip Wire

In order for a coin switch to operate reliably when a coin travels down the secondary coin chute, the rest position of its trip wire should be as shown in Figure 10. Use extreme care when handling or touching these wires.

Mechanical Adjustments on Coin Mechanism

Coin mechanisms are adjusted prior to shipment from the factory and normally will retain these adjustments tor many months. If, due to wear or other causes, it becomes necessary to make new adjustments, remove the coin mechanism from the coin door. Then take it to a clean, well lighted area where it can be placed in a vertical position on a level surface (such as a bench top). Besides a screwdriver, you will need a set of several coins, including both new and old, worn ones. Figure 11 shows an exploded view of the mechanism and gives procedures for adjusting the kicker, separator, and the magnet gate. These adjustments should only be done by someone who has experience in servicing coin mechanisms and who understands their operation.

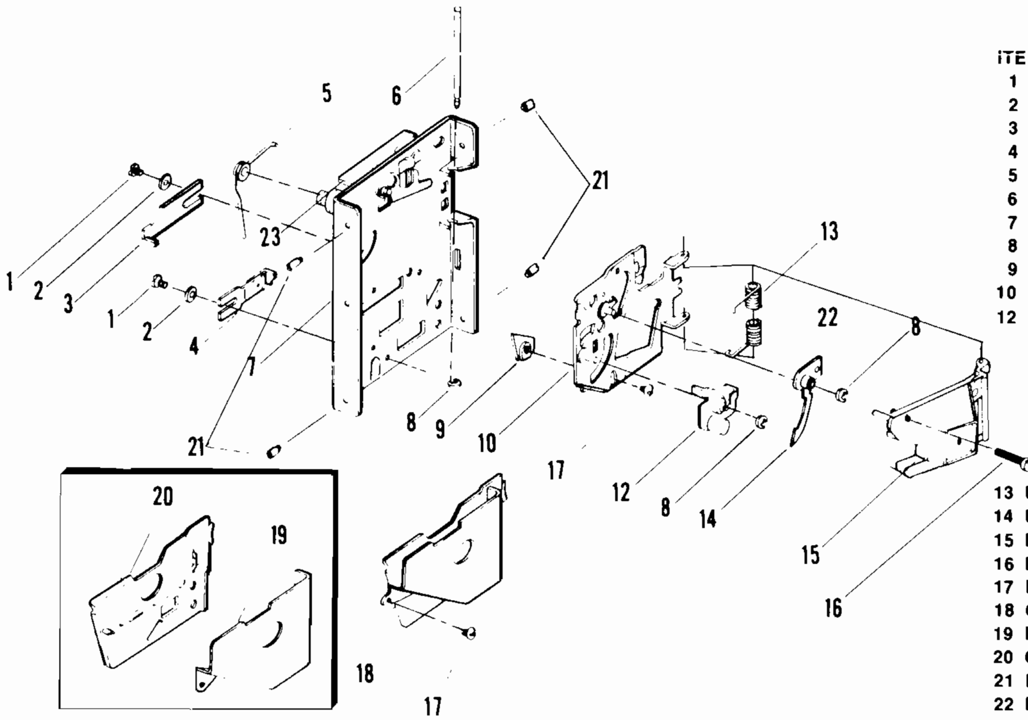
General Troubleshooting Hints

The first action is to look tor jammed coins. After these have been removed, examine the coin path for presence of foreign material or loose objects (such as chewing gum, small metallic objects, paper wads, etc.). In cases where game usage is heavy it may be necessary to clean the entire coin path periodically, in order to prevent build-up of contaminants that can hinder the movement of coins through the mechanisms. Also confirm that the trip wire on each coin switch is intact, and is properly adjusted. If troubles still persist, check the conditions and positions of the lock-out wires, and the mechanical adjustments on the coin mechanisms, before suspecting the electronics. If a coin mechanism rejects genuine coins, try to readjust it. If this is not successful, then replace it with a working mechanism.

C. FUSE REPLACEMENT

Starship 1 contains four fuses, two on the power supply assembly and two on the TV monitor assembly. These fuses are all easily accessible through the rear access door. Replace fuses only with the same type of fuse as follows:

TV Monitor Fuses	3AG 1-amp slow-blow, 250 volts
Power Supply Fuses	3AG 2-amp slow-blow, 250 volts



ITEM IDENTIFICATIONS
1 Kicker and Separator Screws
2 Washers
3 Kicker
4 Separator
5 Gate Lever Spring
6 Gate Pivot Pin
7 Mainplate Assembly
8 "C" washer
9 Rail
10 Gate Assembly
12 Cradle Assembly
13 Upper Gate Pivot Spring
14 Undersize Lever Assembly
15 Magnet Gate Assembly
16 Magnet Gate Adjuster
17 Retaining Screws
18 Coverplate Assembly
19 Return Coverplate
20 Coverplate
21 Mounting Studs
22 Lower Gate Pivot Spring
23 Coin Release Lever

Kicker and separator
1. Set the acceptor with the back of the unit facing you in the test position.
2. Loosen the kicker and separator screws (1) and move the kicker (3) and the separator (4) as far to the right as they will go. Lightly tighten the screws.
3. Insert several test coins (both old and new) and note that some are returned by striking the separator.
4. Loosen the separator screw and move the separator a slight amount to the left. Lightly retighten the screw.
5. Insert the test coins again and, if some are still returned, repeat Step 4 until all the coins are accepted.
6. Loosen the kicker screw and move the kicker as far to the left as it will go. Lightly retighten the screw.
7. Insert the test coins and note that some are returned.
8. Loosen the kicker screw and move the kicker a slight amount to the right. Lightly retighten the screw.
9. Insert the test coins again and, if some are still returned, repeat Step 8 until all the coins are accepted.
10. Be sure that both screws are tight after the adjustments have been made.

Magnet gate
1. Set the acceptor with the front of the unit facing you in the test position.
2. Turn the magnet gate adjusting screw (16) out or counterclockwise until none of the coins will fit through.
3. With a coin resting in the acceptor entrance, turn the adjuster in or clockwise until the coin barely passes through the magnet gate.
4. Test this adjustment using several other coins (both old and new) and, if any fail to pass through the magnet gate, repeat Step 3 until all the coins are accepted.
5. Fix the magnet gate adjusting screw in this position with a drop of glue.

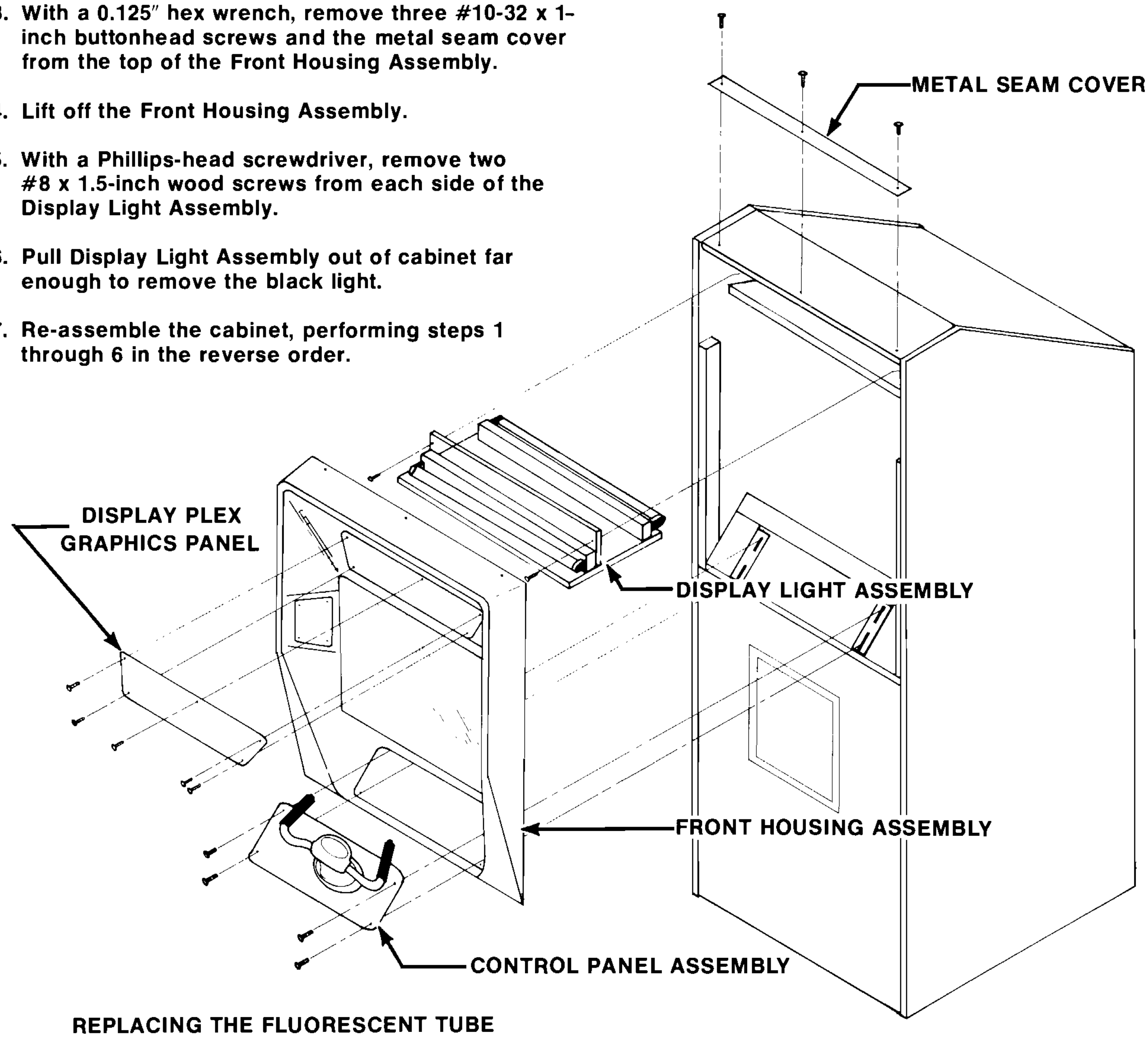
Additional Cleaning
1) Remove the transfer cradle (12) and the undersize lever (14).
2) Use a pipe cleaner or similar effective cleaning tool to clean the bushings and pivot pins.
3) Replace the transfer cradle and the undersize lever.
4) To be certain the coin mechanism is completely free of any residue, place the mechanism in a solution of boiling water and mild detergent for several minutes. Carefully remove it and let it air-dry completely before reinstalling in the door.

Figure 11 Adjustments on Coin Mechanism

REPLACING THE BLACK LIGHT TUBE

Remove the Front Housing Assembly as follows:

1. With a 7/16-inch wrench, reach through the coin door and remove four ¼-20 hex nuts, one at each corner of the Control Panel Assembly.
2. Disconnect the harness connector from the Control Panel Assembly, then remove the Control Panel Assembly.
3. With a 0.125″ hex wrench, remove three #10-32 x 1-inch buttonhead screws and the metal seam cover from the top of the Front Housing Assembly.
4. Lift off the Front Housing Assembly.
5. With a Phillips-head screwdriver, remove two #8 x 1.5-inch wood screws from each side of the Display Light Assembly.
6. Pull Display Light Assembly out of cabinet far enough to remove the black light.
7. Re-assemble the cabinet, performing steps 1 through 6 in the reverse order.



REPLACING THE FLUORESCENT TUBE

1. Remove the Display Plex Graphics Panel by using a 0.125-inch hex wrench to unscrew five #10-32 x 1-inch socket head screws.
2. Remove the fluorescent tube.

Figure 12 Removing the Cabinet Light Assembly

D. LAMP REPLACEMENT

Starship 1 contains five lamps: two cabinet lights, two PROTON TORPEDOS pushbutton lights, and a coin-door light. Cabinet lighting is done with an eighteen-inch fluorescent tube and on the back bezel with an eighteen-inch black light tube. Both the fluorescent and black light tubes are mounted in one lamp assembly. To remove the lamp assembly, follow the instructions in Figure 12.

There are two lamps (Chicago Miniature type #328) in the PROTON TORPEDOS pushbutton. These may be changed by reaching through the coin door. However, if you have had a bad day, you might consider removing the Control Panel Assembly first. This will eliminate the aggravation of working with these tiny bulbs in a tight space. Figure 13 shows how to replace these lamps.

E. REMOVING THE CONTROL PANEL

Removing the Control Panel Assembly can easily be accomplished through the coin door. Reach in with a 7/16-inch wrench and remove the four ¼ x 20-inch hex nuts, split-lock washers and flat washers at each corner of the Control Panel Assembly. Remove the Control Panel Assembly.

F. CONTROL YOKE

The control yoke has two potentiometers. These potentiometers supply player steering information to the game PCB. With a good amount of use, these potentiometers may eventually become dirty and require cleaning. To clean, use a tuner cleaner. This is a spray cleaner that is available at most electronics supplies stores. When you buy tuner cleaner, make sure that you get the long nozzle extension tube that comes with the spray can.

For cleaning the potentiometers, remove the Control Panel Assembly (see Figure 12). Insert the spray nozzle extension tube into each potentiometer, spray, then work the control yoke to make the potentiometers rotate.

G. ADJUSTING THE CRASH CIRCLE

When Starship 1 crashes into another spacecraft or into a planet, an explosion occurs and a crash scene appears on the TV monitor. The crash scene is a circle of negative video. This circle is derived from a complex analog signal which is size-, shape- and position-adjustable.

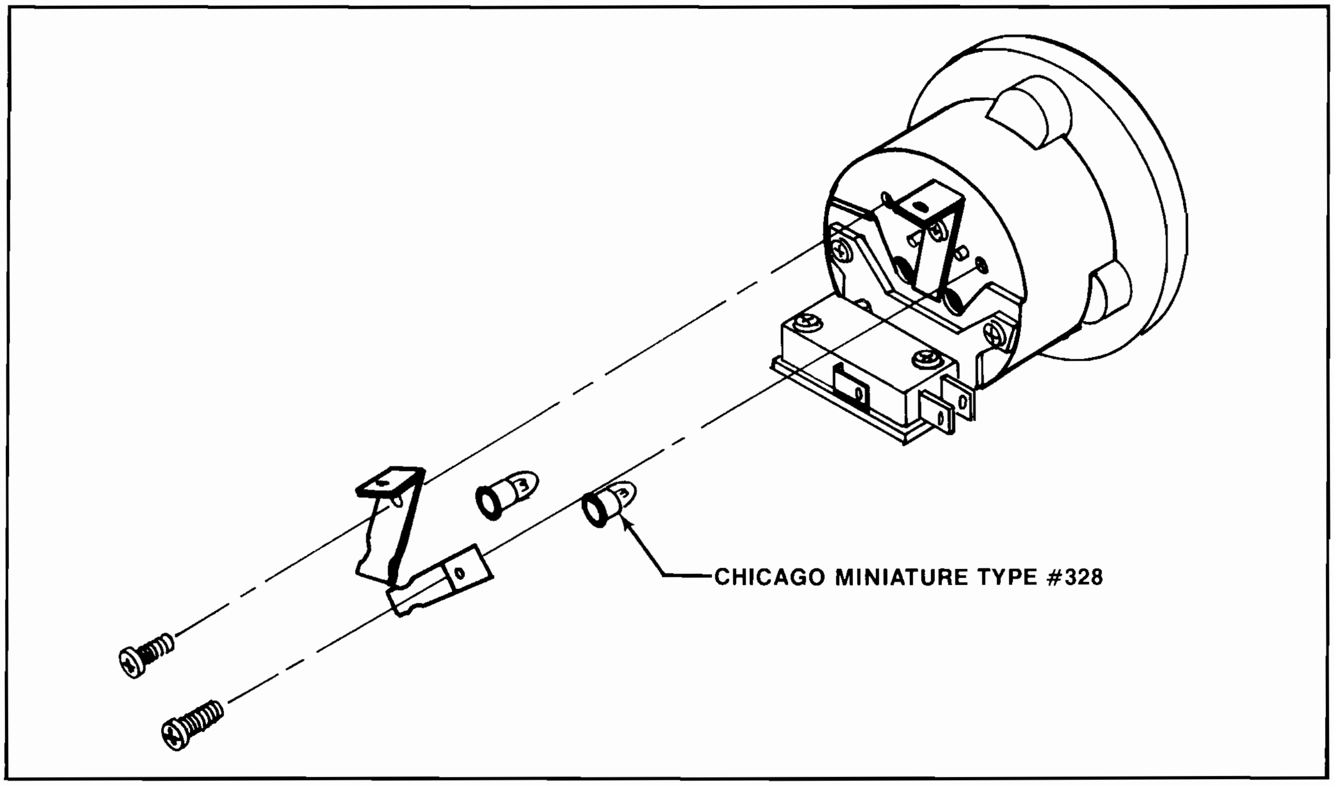


Figure 13 Removing the PROTON TORPEDOS Pushbutton Lamps

To adjust the circle, set all four toggles of DIP switch S2 at location B8 to the *on* position. This will result in the display of all or part of a circle. Refer to Figure 14 for the location of the Circle Generator potentiometers V RAMP AMPLITUDE, H POS, V POS, and DC OFFSET. Adjust potentiometers H POS (horizontal position) and V POS (vertical position) to center the circle. Adjust potentiometer V RAMP AMPLITUDE for a round circle. Then adjust potentiometer DC OFFSET for a circle with a diameter that is about 2/3 the horizontal width of the TV monitor.

After you have adjusted the circle, set all four toggles of SW2 at location B8 to the *off* position. This concludes the adjustment.

H. REMOVING THE TV MONITOR

The TV monitor in Starship 1 may easily be replaced. This is accomplished by opening the rear access door, unplugging the Molex connector from the monitor, removing four securing screws, and sliding the monitor out the back door. See Figure 15 for the location of the securing screws on the monitor.

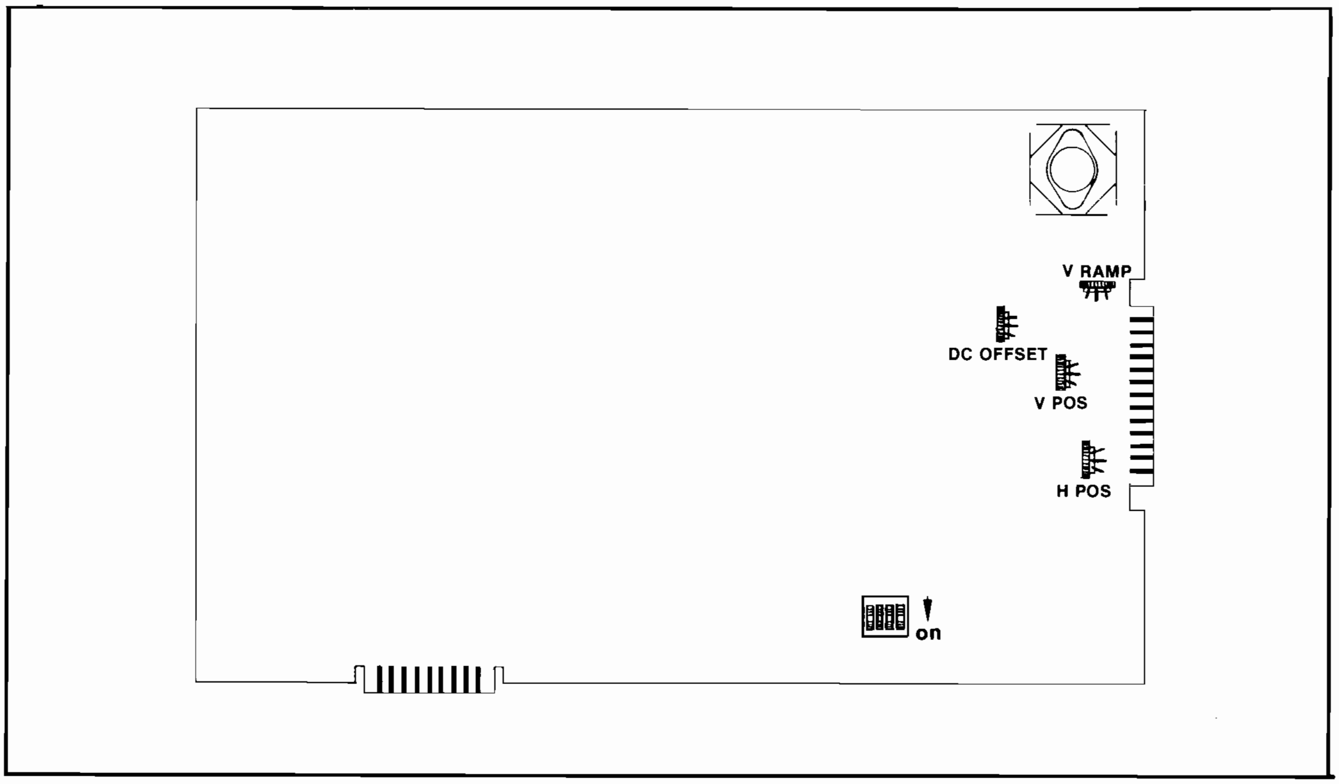
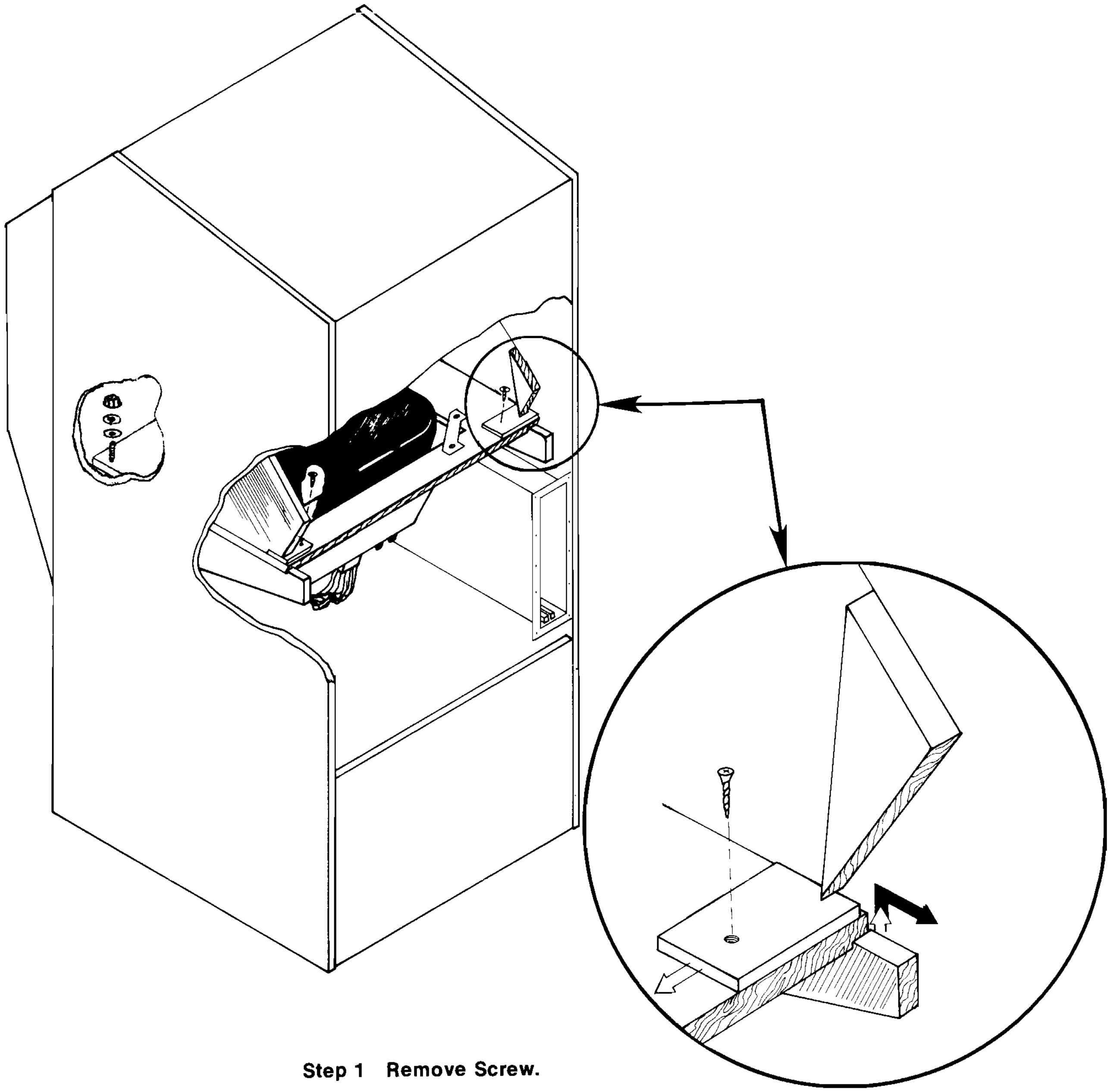


Figure 14 Locations of Crash Circle Adjustments



Step 1 Remove Screw.

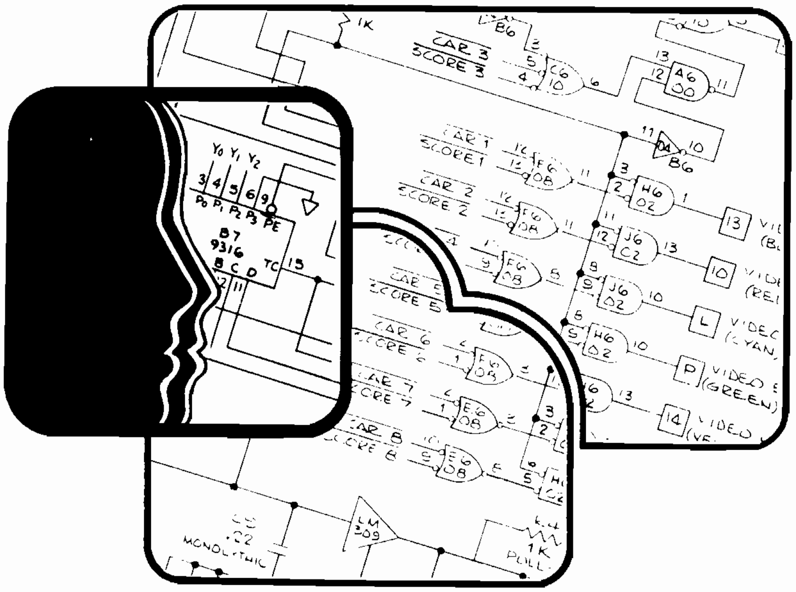
Step 2 Remove wood screws.

Step 3 Reach through coin door and remove two securing nuts (and screws) from front of TV shelf assembly.

Step 4 Unplug Molex connector from TV monitor chassis.

Step 5 Lift back of TV shelf assembly and slide out of cabinet.

Figure 15 Removal of TV Monitor



THEORY OF OPERATION

4

A. GENERAL INFORMATION

The block diagram of Figure 16 shows the major controls, circuits and outputs of the game. Figure 17 is a block diagram of the Starship 1 game PCB.

The game's television monitor is a self-contained transistorized unit. Because the composite video signal sent to the monitor differs in many respects from the signal derived from commercial TV broadcasts, the picture appearing on the screen is unlike that of a home TV set and the monitor does not produce any sound. See Figure 18 for a schematic diagram of the TV monitor.

The game's composite video signal is made to produce only four video levels instead of the more or less continuous shades of grey seen on a home TV screen. The background of the picture is black video level only, but game objects may use any of the four video levels.

On the game PCB schematic diagram, Figure 20, the symbol "P" (appearing at various inputs of integrated circuit devices) indicates a connection of +5 volts DC through a pullup resistor. For easy reference, the game PCB is divided into grid sections. Along the short side of the board these sections are identified by letters A through R (skipping letters G, I, O and Q because they may be easily confused with the numbers 6, 10, and 0 respectively). Along the long side of the board the numbers 1 through 12 are used. For example, sheet 1 of Figure 20 illustrates the type-MC1495 analog multiplier F11 at the lower left of the drawing. This device F11 will be found at coordinates F and 11 on the PCB.

Figure 19 is a harness schematic of the entire Starship 1 game. This figure illustrates how all electrical and electronic assemblies are electrically connected together.

B. POWER SUPPLIES (lower right corner of sheet 1, Figure 20)

The two AC voltage inputs to the board come from the 25 VAC and 16.5 VAC center-tapped secondary windings of the power transformer inside the Power Supply Assembly. The +5 volt regulated supply provides V_{cc} for most of the board's integrated circuits. The +12 volt and −12 volt regulated supplies provide lower-current voltages for analog circuitry on the game PCB. The unregulated +18 volts connects to the audio driver stage for the game's audio output.

C. CRYSTAL OSCILLATOR AND TV SYNC COUNTDOWN CHAINS

A 12.096-MHz crystal oscillator (sheet 1 of Figure 20) generates the basic clock frequency that is divided down to produce the TV synchronization signals. The signals used to produce a TV monitor raster consisting of 262 horizontal lines at a horizontal frequency of 15,750 Hz (256H). Synchronized with line 240 is a vertical blanking pulse that occurs for the duration of 22 more horizontal scans, resulting in the total number of 262 lines per picture frame.

Besides being used for the TV raster, the TV timing signals are also used in the motion circuits, in the alphanumerics display circuit, in the phasor generator, in the microcomputer clock and in various other places on the board.

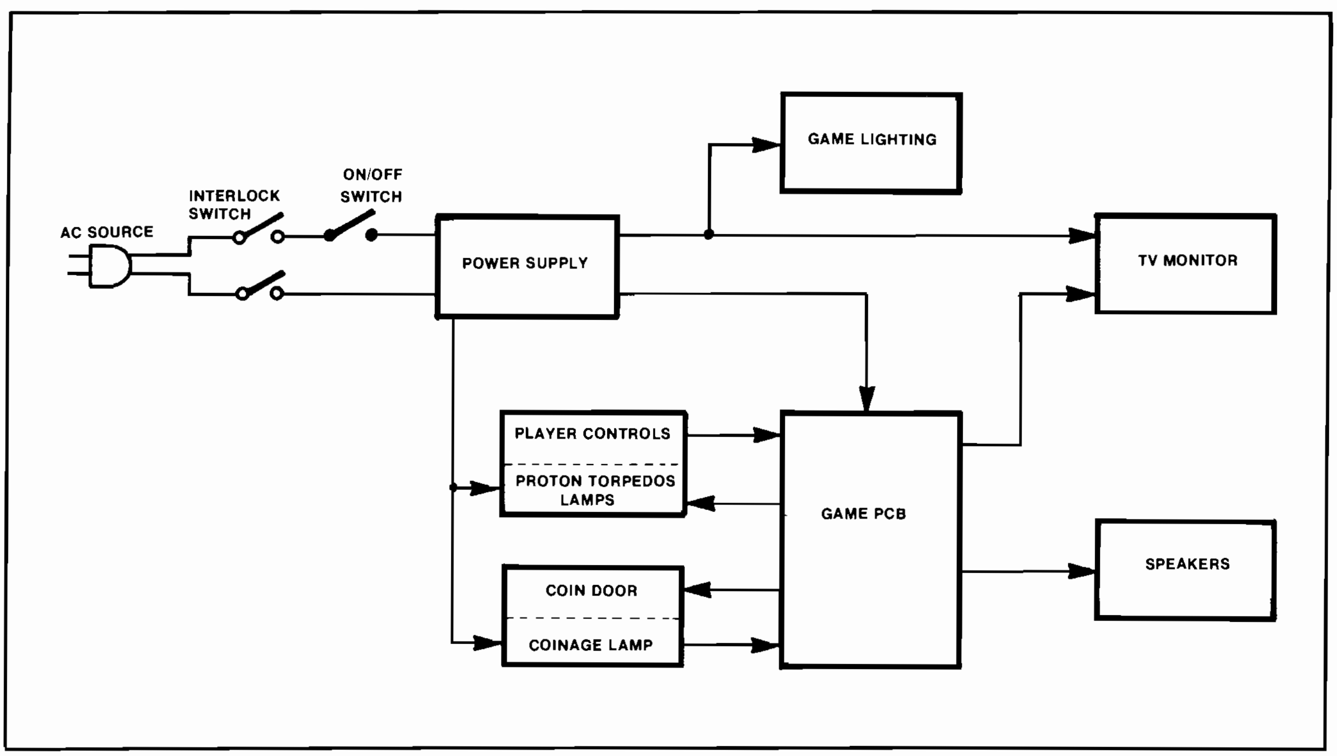


Figure 16 Starship 1 Game Block Diagram

D. MICROCOMPUTER

The microcomputer is the control center for the action of the circuitry that makes up the game. The microprocessing unit (MPU) send out addresses on its address bus and accepts data or outputs data onto the data bus. When the MPU is reset, by receiving first a low level and then a high level on its $\overline{RESET}$ line, it outputs addresses that cause the program memory to put data onto the data bus. The MPU reads this data and uses it to address the main program.

The program instructs the MPU what operations to execute and at which address to execute them. This controls the flow of data on the bus and "reads" inputs and "writes" to outputs. Data may flow into the MPU from program memory, "zero page" read/write random-access memory (RAM) and through the transceivers from the Data In bus (D1N7 is one line of this bus) which comes from the data input selectors.

Data may flow out of the MPU to zero-page RAMs or through the transceivers to the Buffered Data bus (BD7 is one line of this bus) to the following output interfaces: the message RAM, the digital output section, the digital-to-analog converter (DAC) section, and the position RAM in the motion circuitry.

The interrupt request ($\overline{IRQ}$) line of the MPU comes from the coin switches. If the line stays low rather than pulses low, it will cause the game to display "COIN" on the screen, indicating a broken line, bad switch or jammed coin mech.

E. INPUT/OUTPUT

Digital Output

The digital outputs of the MPU consist of decodes and data outputs. The decodes respond to various outputs of the address bus and enable the appropriate sections of the circuit to become active. For example, the state of the address bus can determine if the player up/down control is being sensed, or if alphanumeric messages are being output.

Digital outputs or control signals, such as PHASOR ON, are levels or pulses required to perform various tasks to output game video and audio.

Decodes also enable the transceivers to transfer data from the Data In bus to the Data bus, or to put data from the Data bus onto the Buffered Data bus, or to be put into an *off* state (so that data is input from program memory or zero-page RAM) or output to RAMs.

Address buffers are merely digital followers to provide enough power for the addresses to fully drive the TTL loads on the Buffered Address bus (BA9). The Buffered Address bus always exactly follows the Address Bus (AB9) from the MPU.

Analog output is produced by the Digital-to-Analog Converter (DAC) that produces a string of analog voltages corresponding to data on the DAC input. This string of values is demultiplexed to individual voltage level outputs by the analog demultiplexer. The signals are spaceship size (SSSIZE), noise amplitude, tone pitch, motor speed, circle horizontal (H POSITION), circle vertical (V POSITION), and circle size.

Inputs

Analog inputs consist of three voltage levels: up/down control, left/right steering, and game time. These go to the Analog-to-Digital (A/D) converter. A fourth input, a feedback line from the DAC, is not used. The Analog multiplexer (N11) selects which source to input to the comparator (L11). When the A/D RAMP voltage passes the level of the selected input, a flip-flop (F7) clocks in the change and causes another flip-flop group (J7) to clock in a digital value corresponding to the level. This value is then input through the digital input selectors.

Digital Inputs are chosen by the selectors (E6, F6, J6 and H6) according to the address the MPU outputs. Sources for the inputs are the D/A value, game digital logic inputs (such as RDATA4 or EXPLOSION), game option switches and game cabinet switches. The switches are start, coin 1, coin 2, test, slow, laser and the proton torpedo switch.

F. VIDEO SECTION

The video section consists of the circuits that generate the video and the output area which assembles the composite video signal. The microcomputer writes data to the motion RAMS (J4, K4, L4, M4 and N4) to specify the objects and directions of all motion objects.

G. STARFIELD CIRCUIT

The starfield generator is a two-shift-register noise generator (D-E5) to produce the fixed starfield and the "grain" seen in the planets.

H. SPACESHIP CIRCUIT (Patent Pending)

The spaceship circuit has a voltage-controlled oscillator (VCO, at E11); the VCO produces a clock to

run counters that address the ROMs containing the spaceship pictures. If the VCO runs fast, the counters count through the picture very fast and the resulting picture is small.

As a spaceship grows in size, the frequency from the VCO becomes lower and objects appear larger.

I. LASER CIRCUIT

The laser circuit is fired by PHASOR ON and produces the signal (M6, N6) that makes the laser apear in the video.

J. ALPHANUMERICS GENERATOR

Messages are stored in RAMs K7 and M7 and are output by sync functions which address the alphanumerics ROM, N7. This data is loaded into shift register P7 and shifted out into the video.

Adressing of the RAM is controlled by selectors K8, M8 and N8 which use sync functions to display the RAM, but use MPU addresses to write into the RAM.

K. CIRCLE GENERATOR

The circle generator begins with a current source to bias Q1, Q2 and Q3 to produce the following ramps: A/D RAMP; H RAMP and VRAMP. A/D ramp is only used in the analog input section, not in the circle. The H and V ramps are each adjusted to cross zero, then are multiplied (multipliers F11 and J11). Then they are summed and fed to comparator L11 which decides whether the video is scanning within the circle.

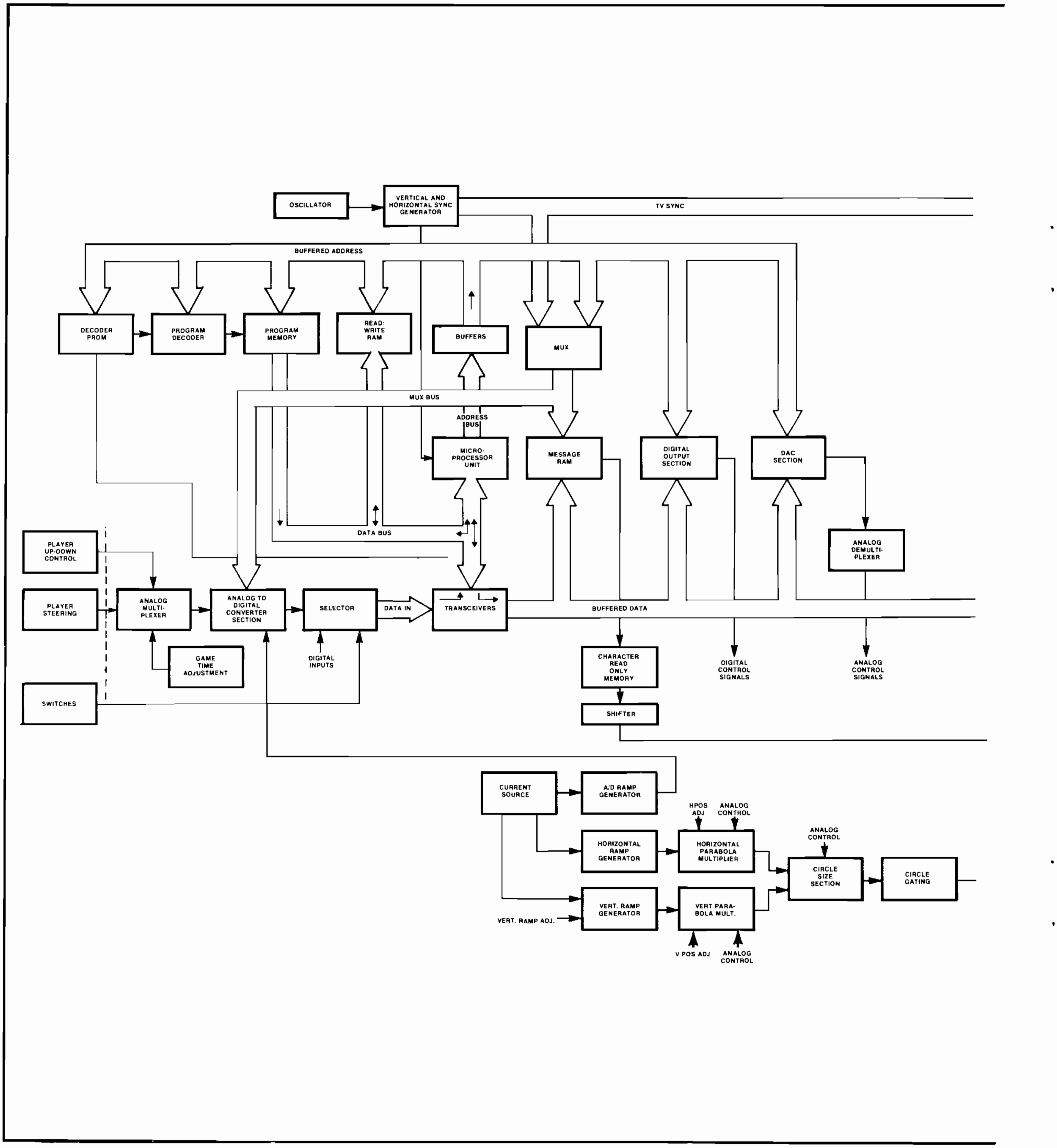
L. VIDEO PRIORITY CIRCUIT

All video comes to the ROM R10 which gives appropriate priority to all video. Outputs are through R11 to form the composite video containing sync blanking and all images.

M. AUDIO SECTION

The laser generator is a 556 located C10 used to produce the distinctive laser sound. Noise is generated by the shift registers B9 and C9 and is fed to the E10-D11 noise filter. This filter produces different sounds for the "whoosh" of a planet, the crash and the explosion. The motor sound is made by a 566 at A9, and its level is controlled by the signal MO/LVL.

Variable tones are produced by the 4136 (at E10) and the 555 at B10. Level control is provided by SL1 and SL2. All audio is summed at the volume control and goes to the TDA1004 audio amplifier and from there to the speakers.


OSCILLATOR
VERTICAL AND HORIZONTAL SYNC GENERATOR
TV SYNC
BUFFERED ADDRESS
DECODER PROM
PROGRAM DECODER
PROGRAM MEMORY
READ: WRITE RAM
BUFFERS
MUX
MUX BUS
ADDRESS BUS
MICRO-PROCESSOR UNIT
MESSAGE RAM
DIGITAL OUTPUT SECTION
DAC SECTION
DATA BUS
ANALOG DEMULTI-PLEXER
PLAYER UP-DOWN CONTROL
PLAYER STEERING
ANALOG MULTI-PLEXER
ANALOG TO DIGITAL CONVERTER SECTION
SELECTOR
DATA IN
TRANSCEIVERS
BUFFERED DATA
GAME TIME ADJUSTMENT
DIGITAL INPUTS
SWITCHES
CHARACTER READ ONLY MEMORY
DIGITAL CONTROL SIGNALS
ANALOG CONTROL SIGNALS
SHIFTER
CURRENT SOURCE
A/D RAMP GENERATOR
HPOS ADJ
ANALOG CONTROL
HORIZONTAL RAMP GENERATOR
HORIZONTAL PARABOLA MULTIPLIER
ANALOG CONTROL
CIRCLE SIZE SECTION
CIRCLE GATING
VERT. RAMP GENERATOR
VERT PARA-BOLA MULT.
VERT. RAMP ADJ.
V POS ADJ
ANALOG CONTROL

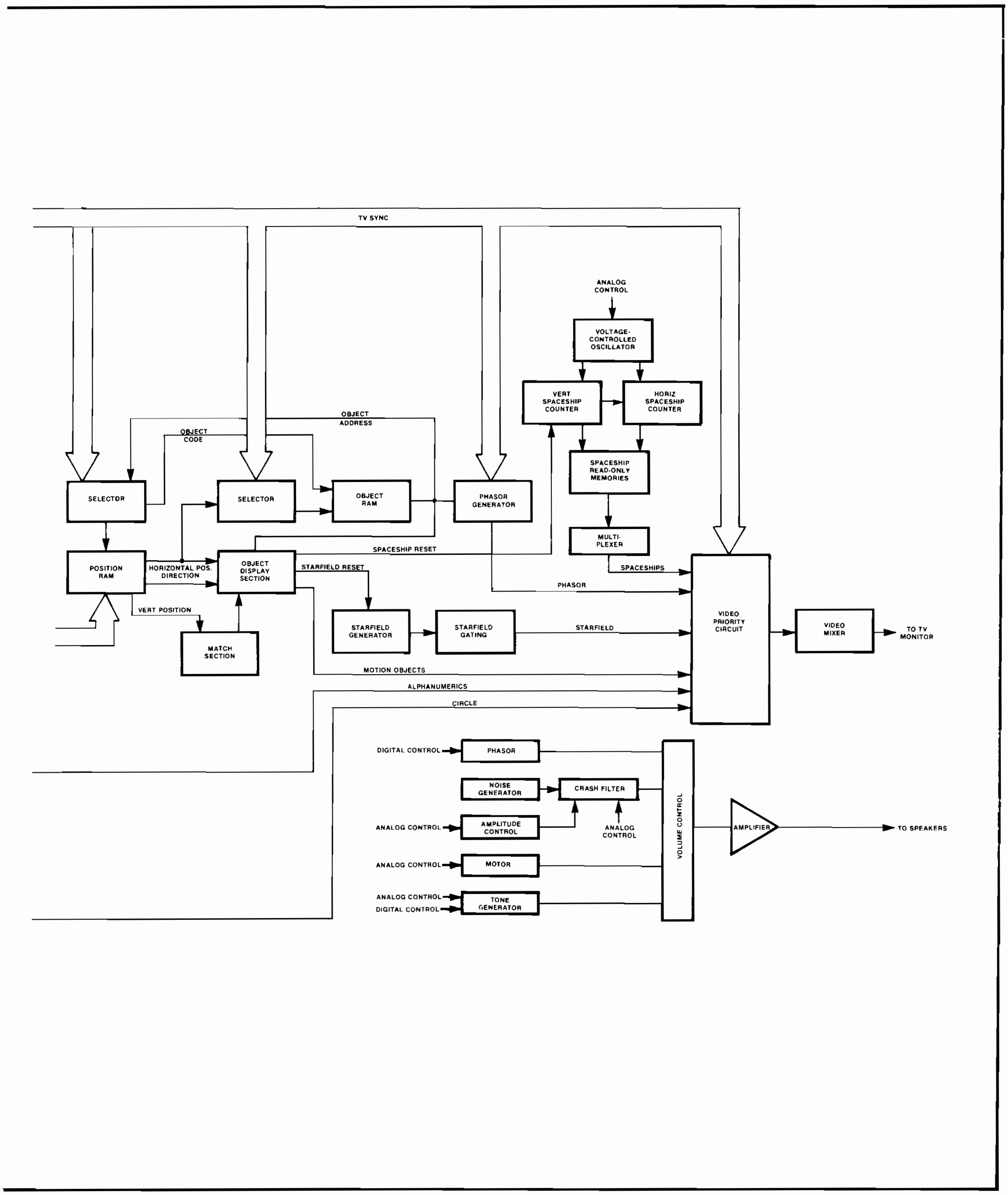


Figure 17 Starship 1 PCB Block Diagram

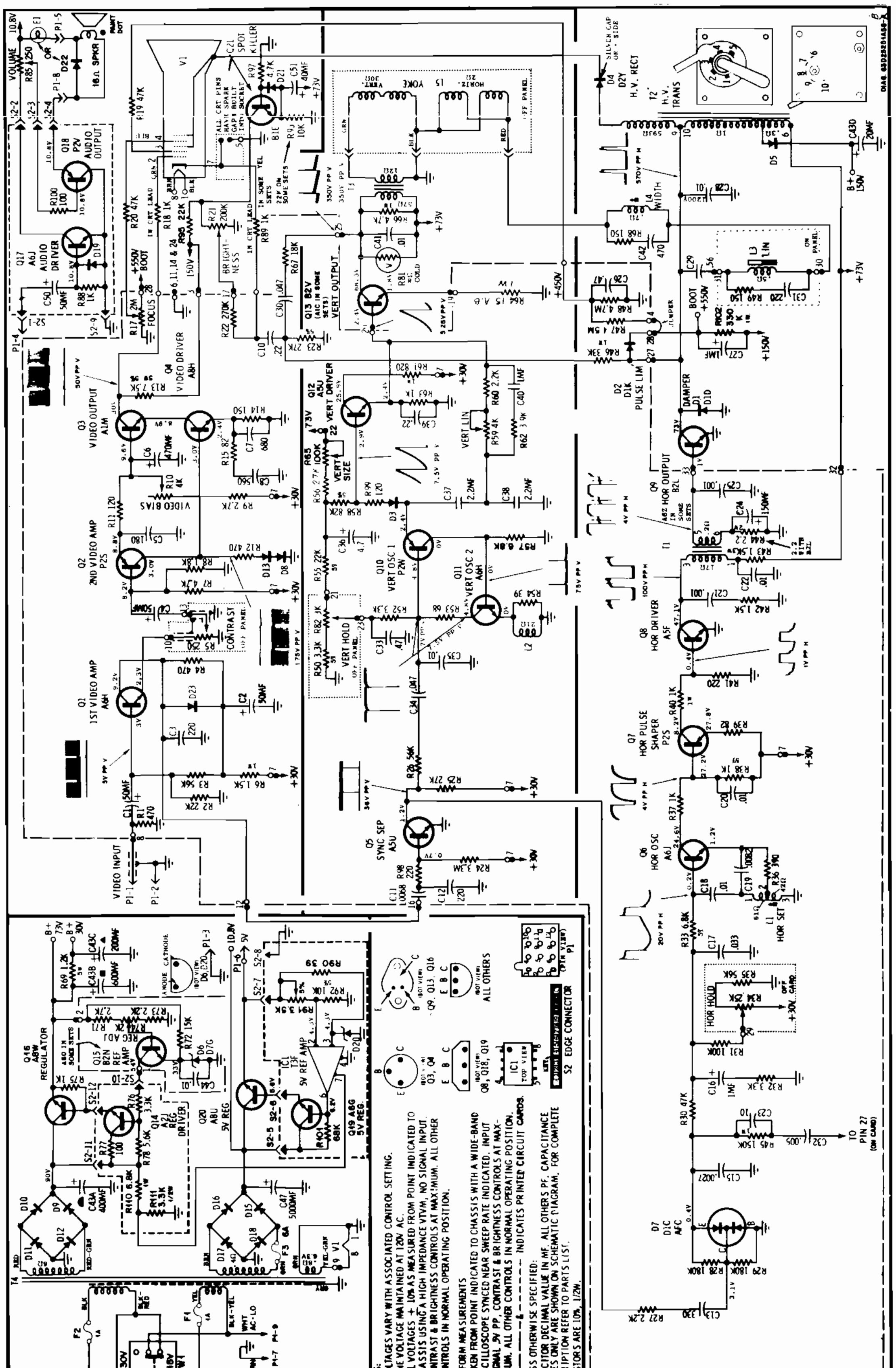
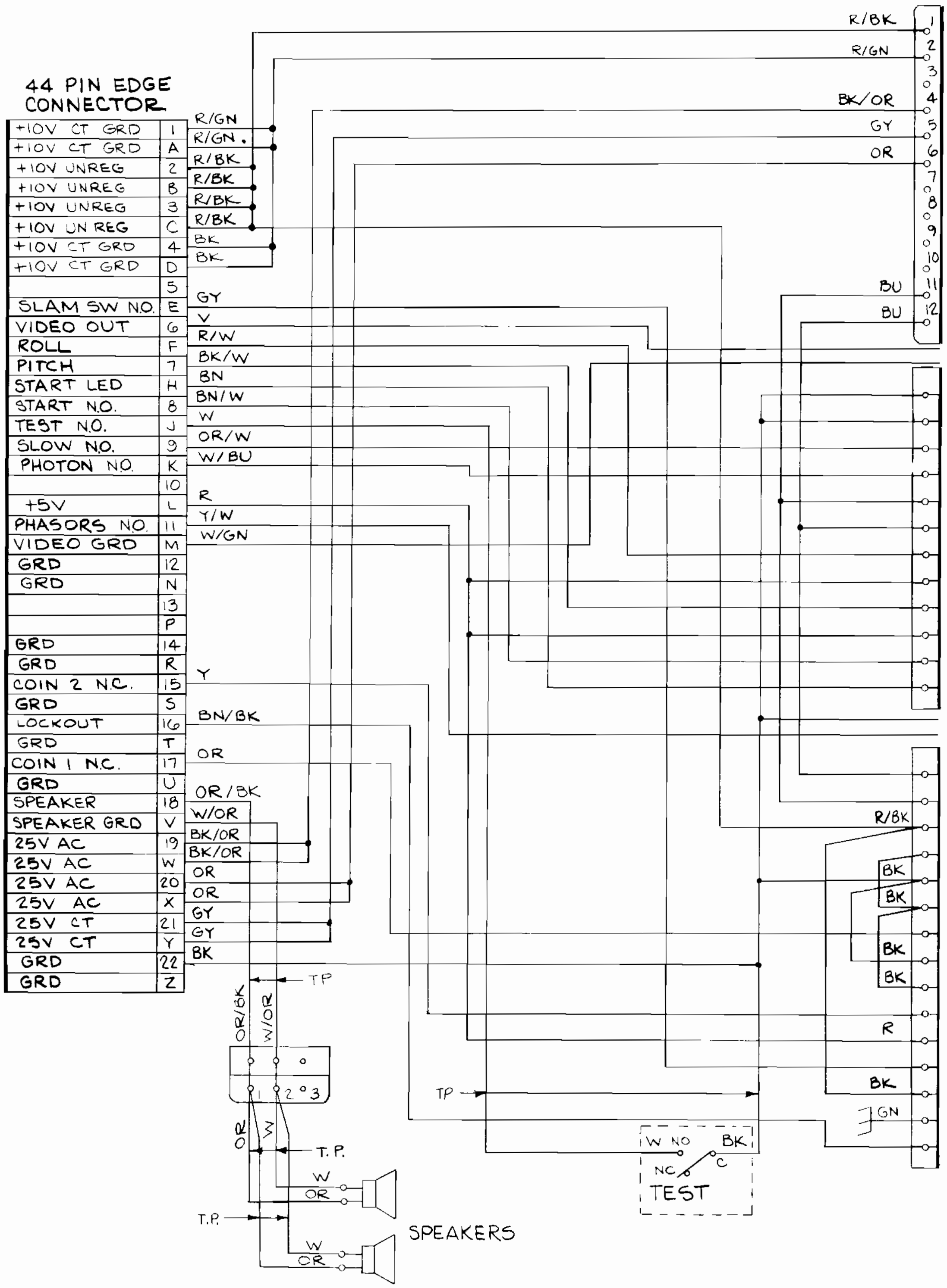


Figure 18 TV Monitor Schematic



44 PIN EDGE CONNECTOR
+10V CT GRD
+10V UNREG
+10V UN REG
SLAM SW NO.
VIDEO OUT
ROLL
PITCH
START LED
START N.O.
TEST N.O.
SLOW N.O.
PHOTON N.O.
+5V
PHASORS NO.
VIDEO GRD
GRD
COIN 2 N.C.
LOCKOUT
COIN 1 N.C.
SPEAKER
SPEAKER GRD
25V AC
25V CT
R/GN
R/BK
BK
GY
V
R/W
BK/W
BN
BN/W
W
OR/W
W/BU
R
Y/W
W/GN
Y
BN/BK
OR
OR/BK
W/OR
BK/OR
BK/OR
BU
TP
T.P.
W NO
NC
C
TEST
SPEAKERS

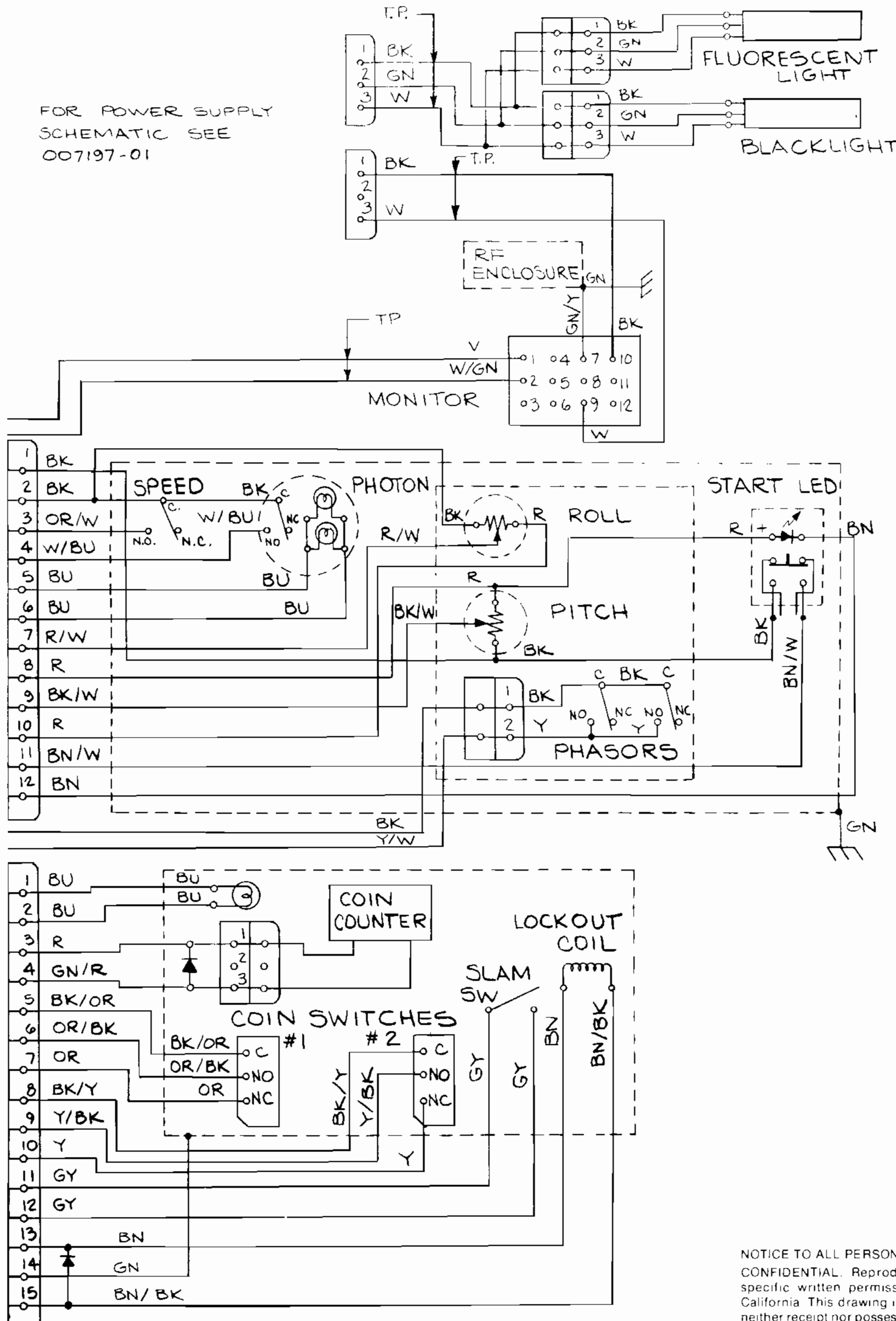
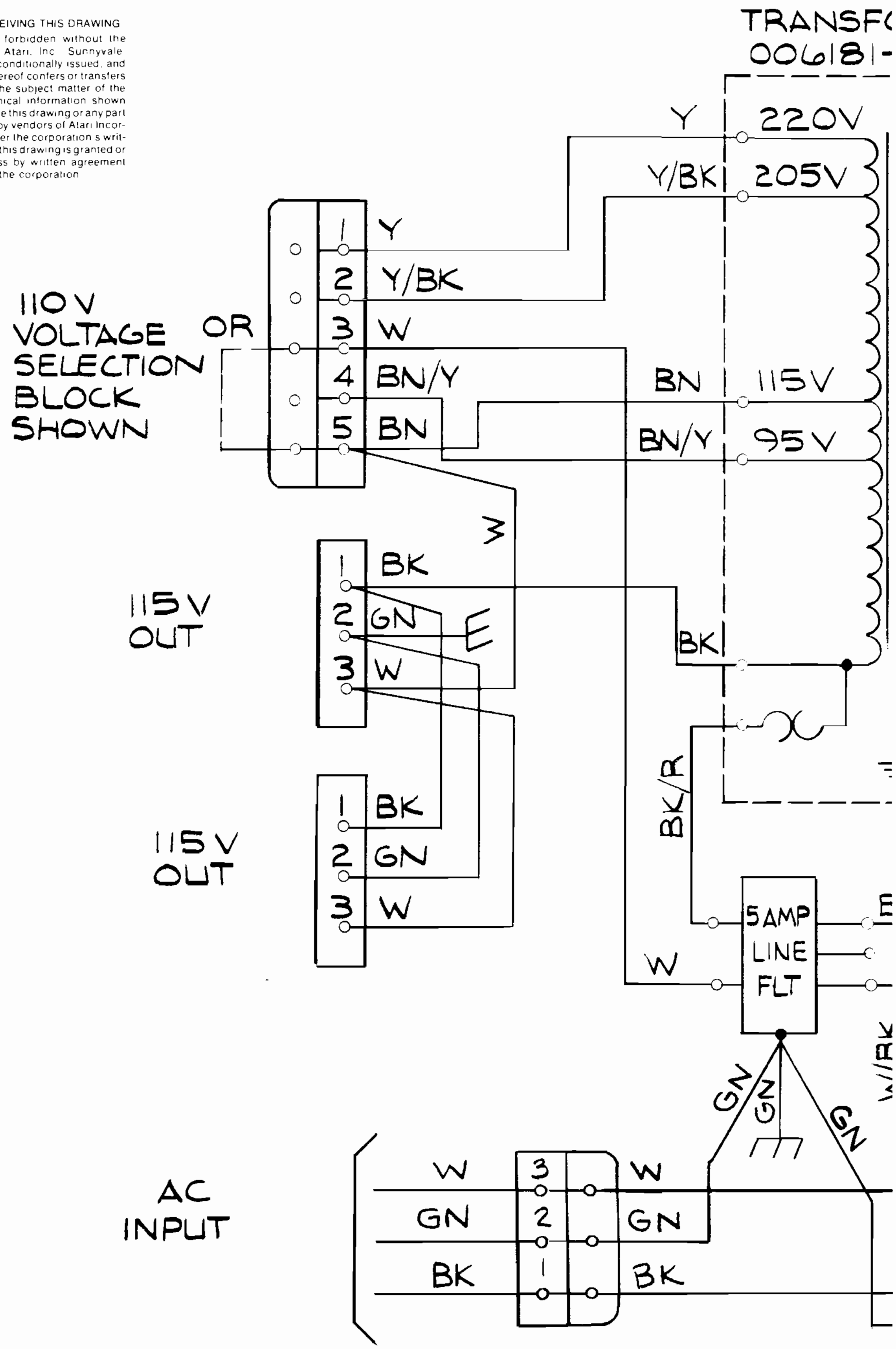
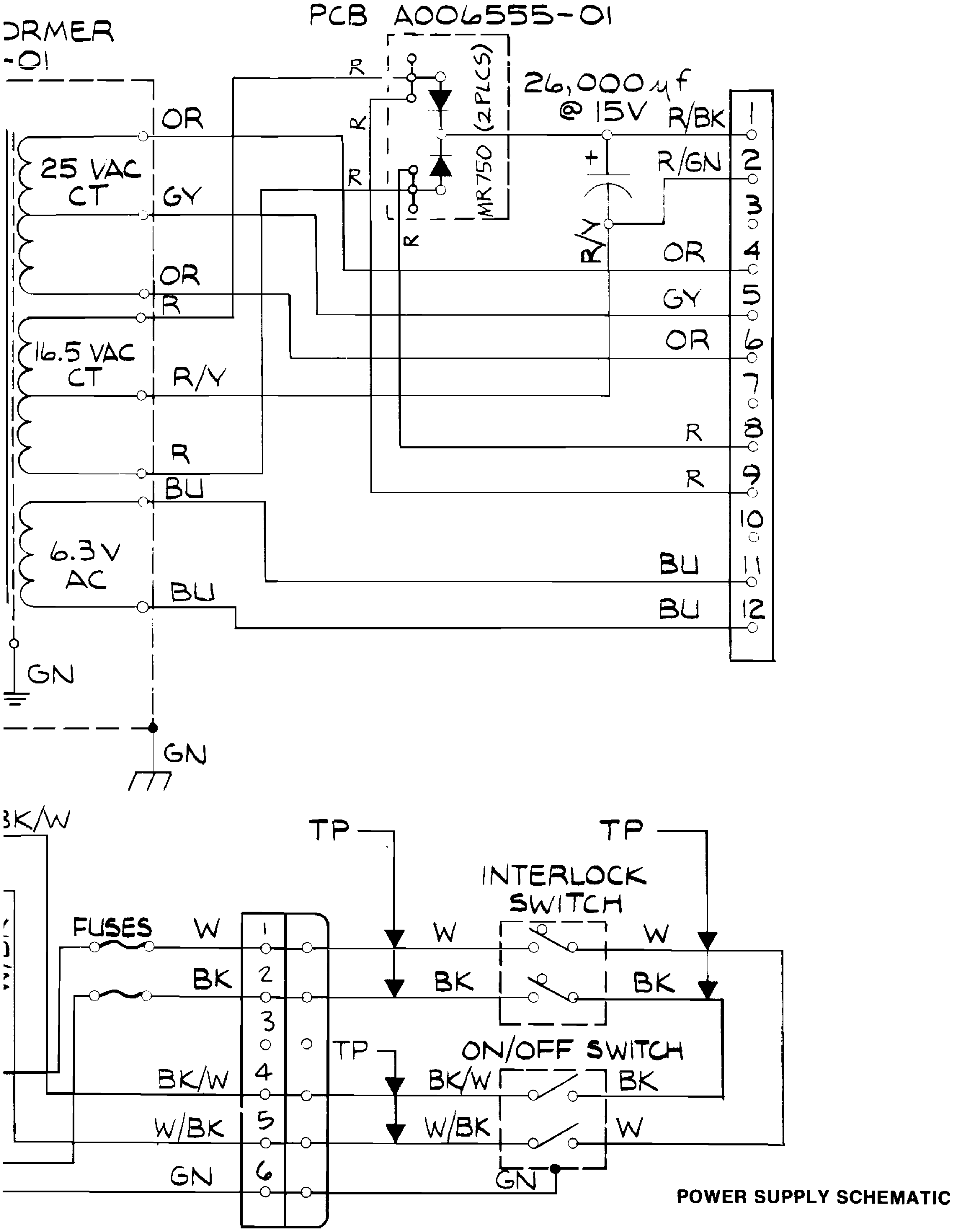


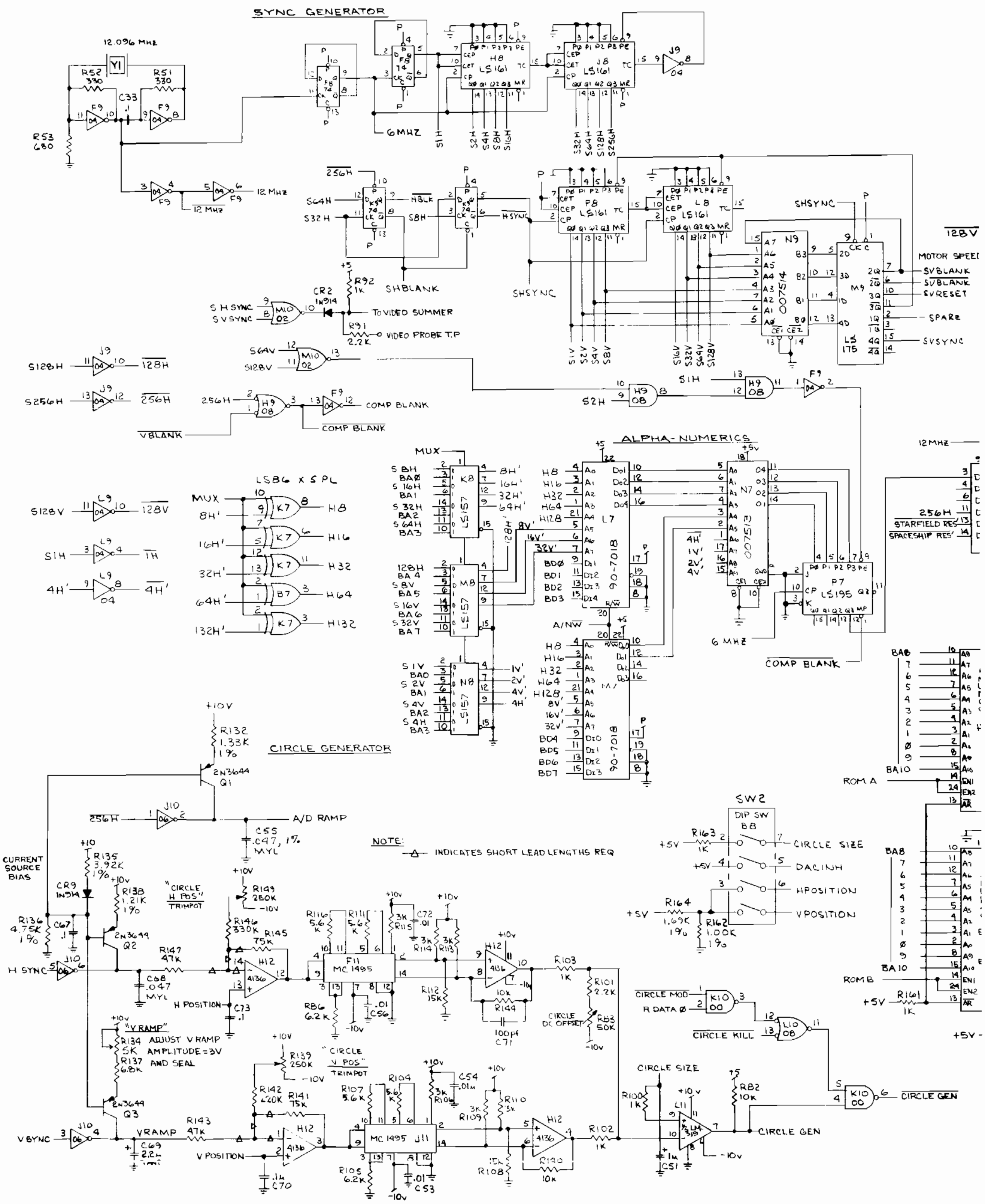
Figure 19 Starship 1 Game Harness Diagram (Sheet 1 of 2)


TRANSF
00618I-
Y
220V
Y/BK
205V
110V VOLTAGE SELECTION BLOCK SHOWN
OR
1 Y
2 Y/BK
3 W
4 BN/Y
5 BN
BN
115V
BN/Y
95V
W
115V OUT
1 BK
2 GN
3 W
E
BK
BK/R
115V OUT
1 BK
2 GN
3 W
5AMP LINE FLT
W
GN
GN
GN
AC INPUT
W
GN
BK
3
2
1
W
GN
BK



POWER SUPPLY SCHEMATIC

Figure 19 Starship 1 Game Harness Diagram (Sheet 2 of 2)



SYNC GENERATOR
12.096 MHz
6MHZ
12 MHz
SHBLANK
SHSYNC
TO VIDEO SUMMER
VIDEO PROBE T.P.
COMP BLANK
VBLANK
MOTOR SPEED
SVBLANK
SVRESET
SPARE
SVSYNC
ALPHA-NUMERICS
LS86 X 5 PL
MUX
A/NW
6 MHZ
ROM A
ROM B
CIRCLE GENERATOR
A/D RAMP
NOTE: INDICATES SHORT LEAD LENGTHS REQ
CURRENT SOURCE BIAS
"CIRCLE H POS" TRIMPOT
H SYNC
H POSITION
"V RAMP" ADJUST V RAMP AMPLITUDE = 3V AND SEAL
"CIRCLE V POS" TRIMPOT
V SYNC
VRAMP
V POSITION
CIRCLE DC OFFSET
SW2
DIP SW
CIRCLE SIZE
DACINH
HPOSITION
VPOSITION
CIRCLE MOD
R DATA Ø
CIRCLE KILL
CIRCLE GEN

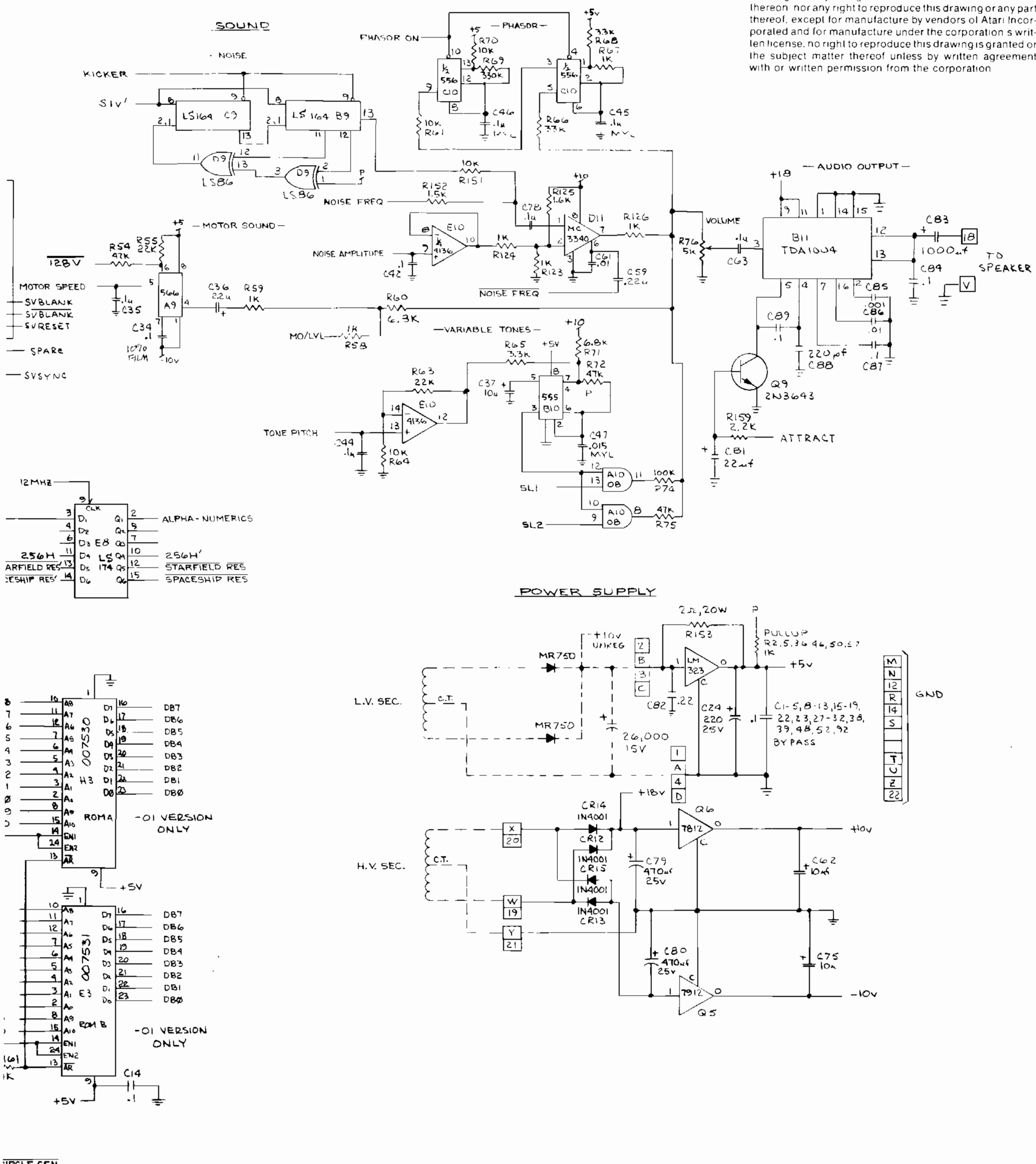
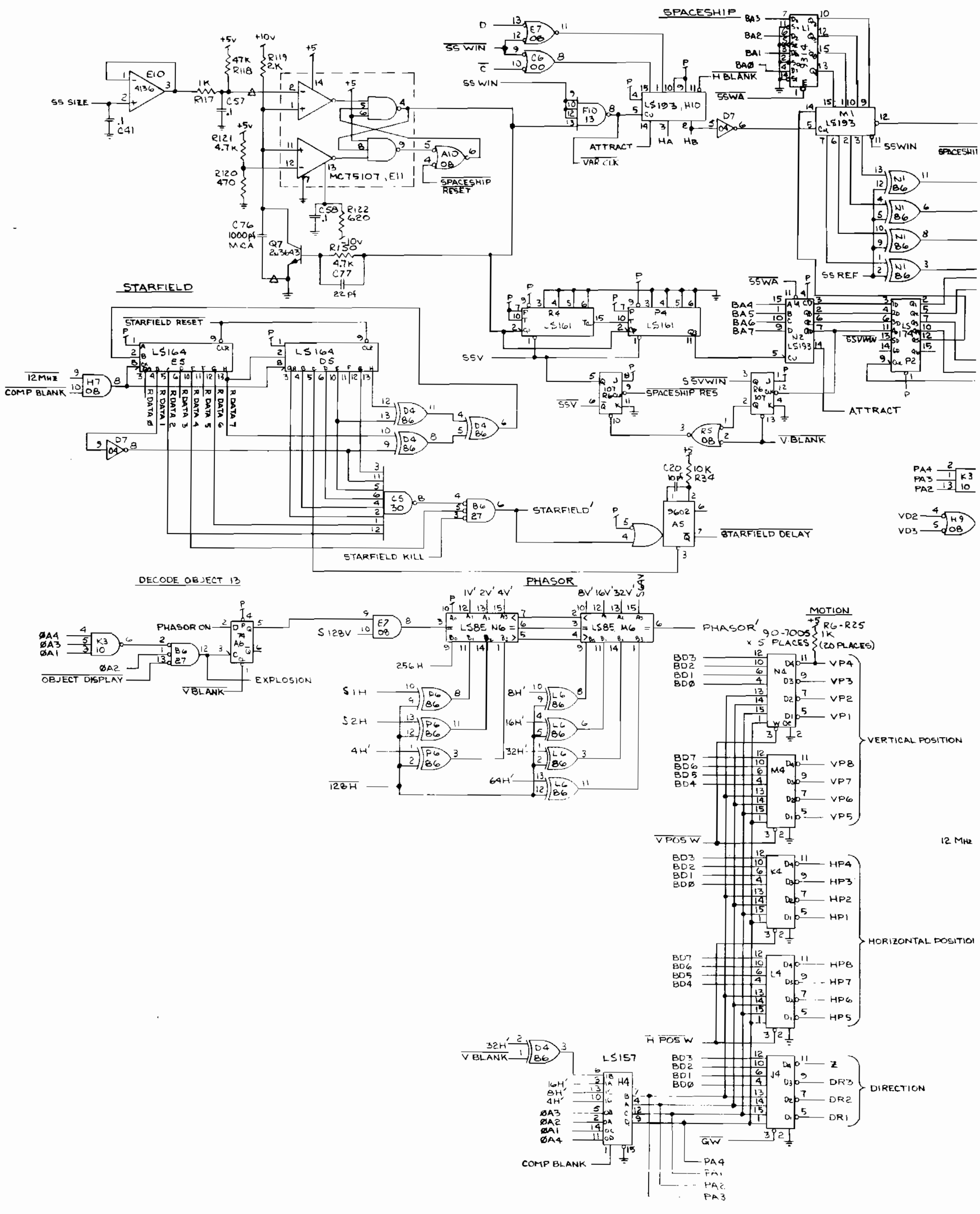
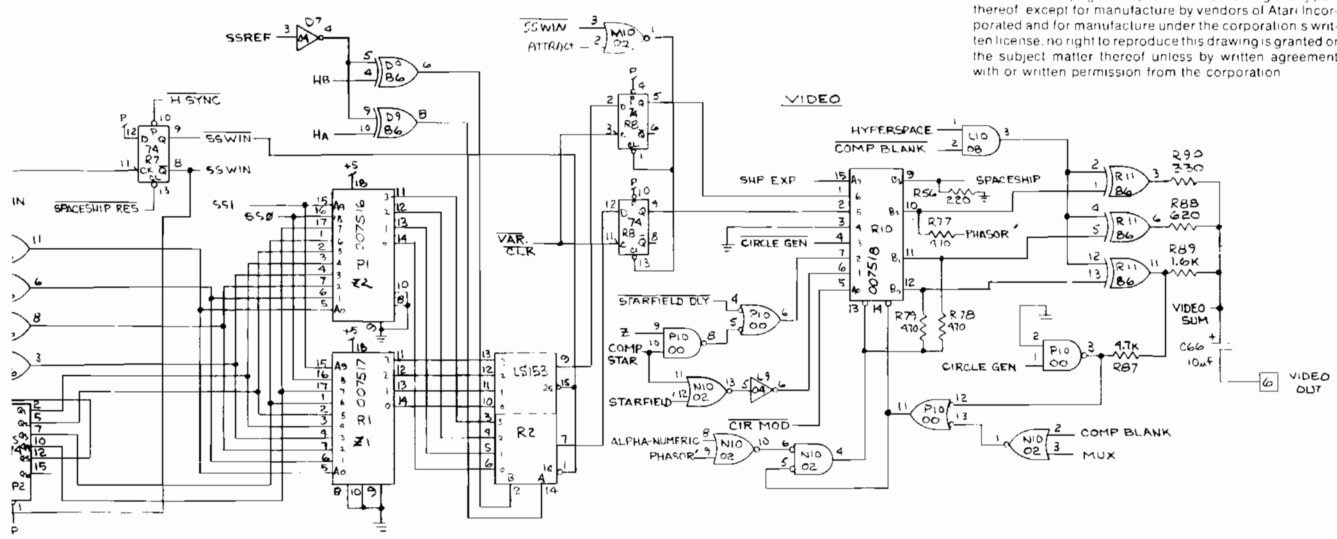


Figure 20 Starship 1 PCB Schematic Diagram (Sheet 1 of 3)


SPACESHIP
STARFIELD
DECODE OBJECT 13
PHASOR
MOTION
SS SIZE
SS WIN
SPACESHIP RESET
MC75107, E11
ATTRACT
VAR CLK
H BLANK
SSWA
SS REF
SSV
SPACESHIP RES
SSVWIN
V BLANK
STARFIELD RESET
12 MHz
COMP BLANK
STARFIELD'
STARFIELD KILL
STARFIELD DELAY
PHASOR ON
OBJECT DISPLAY
EXPLOSION
S 128V
PHASOR'
VERTICAL POSITION
HORIZONTAL POSITION
DIRECTION
V POS W
H POS W
GW
LS157



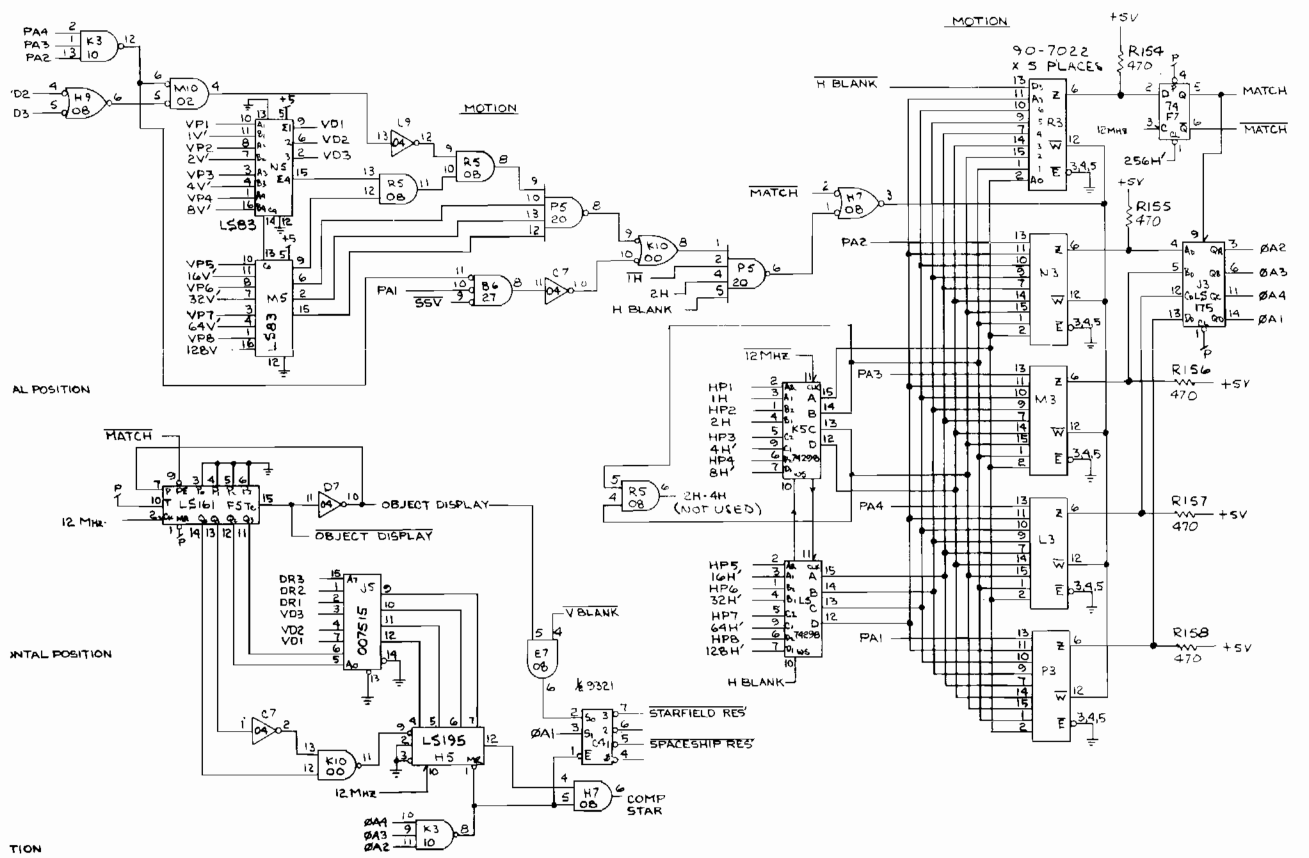
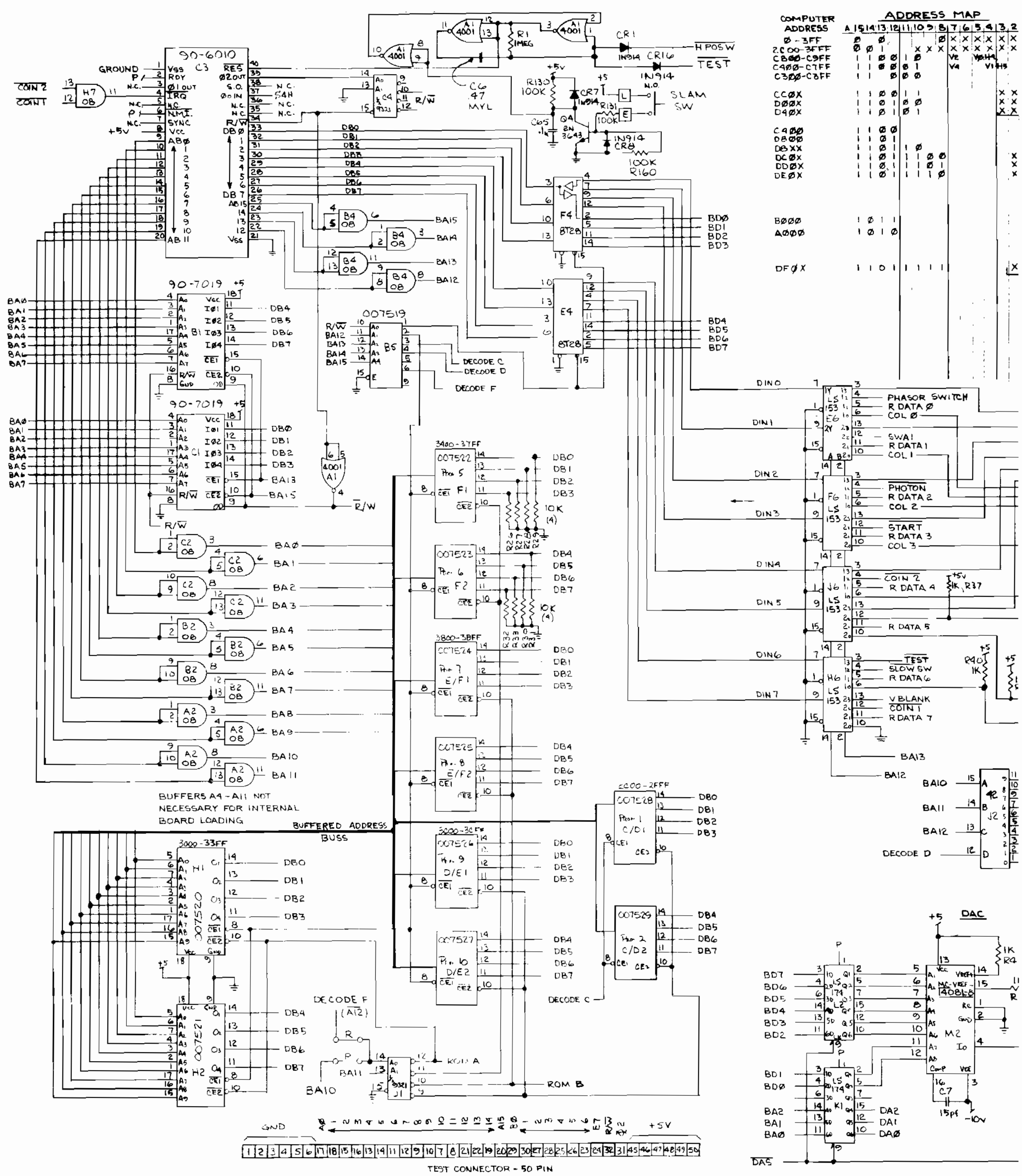


Figure 20 Starship 1 PCB Schematic Diagram (Sheet 2 of 3)



COMPUTER ADDRESS
ADDRESS MAP
90-6010
90-7019
007519
BUFFERS A4-A11 NOT NECESSARY FOR INTERNAL BOARD LOADING
BUFFERED ADDRESS BUSS
PHASOR SWITCH
PHOTON
START
SLAM SW
DECODE C
DECODE D
DECODE F
ROM A
ROM B
DAC
TEST CONNECTOR - 50 PIN

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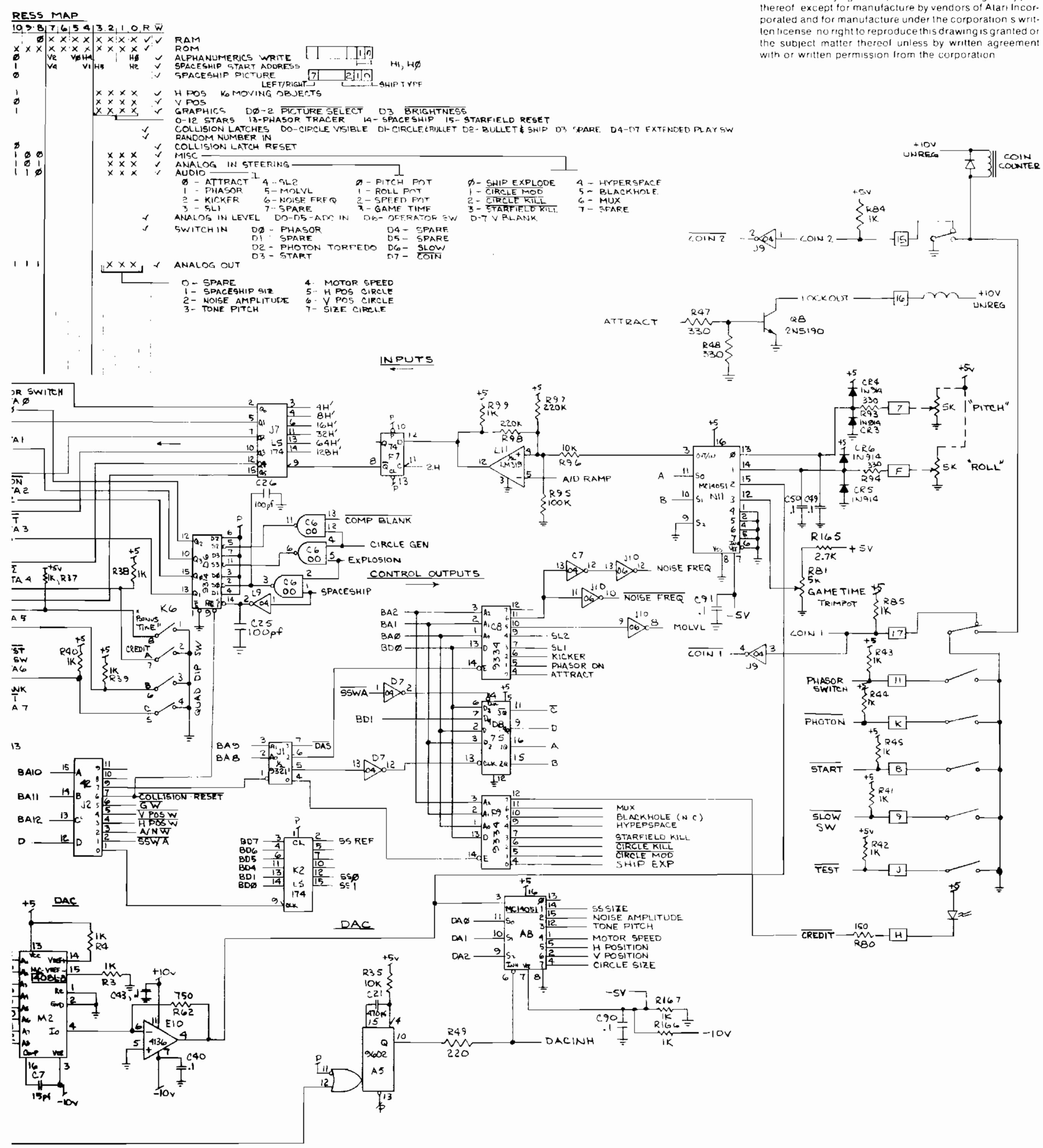
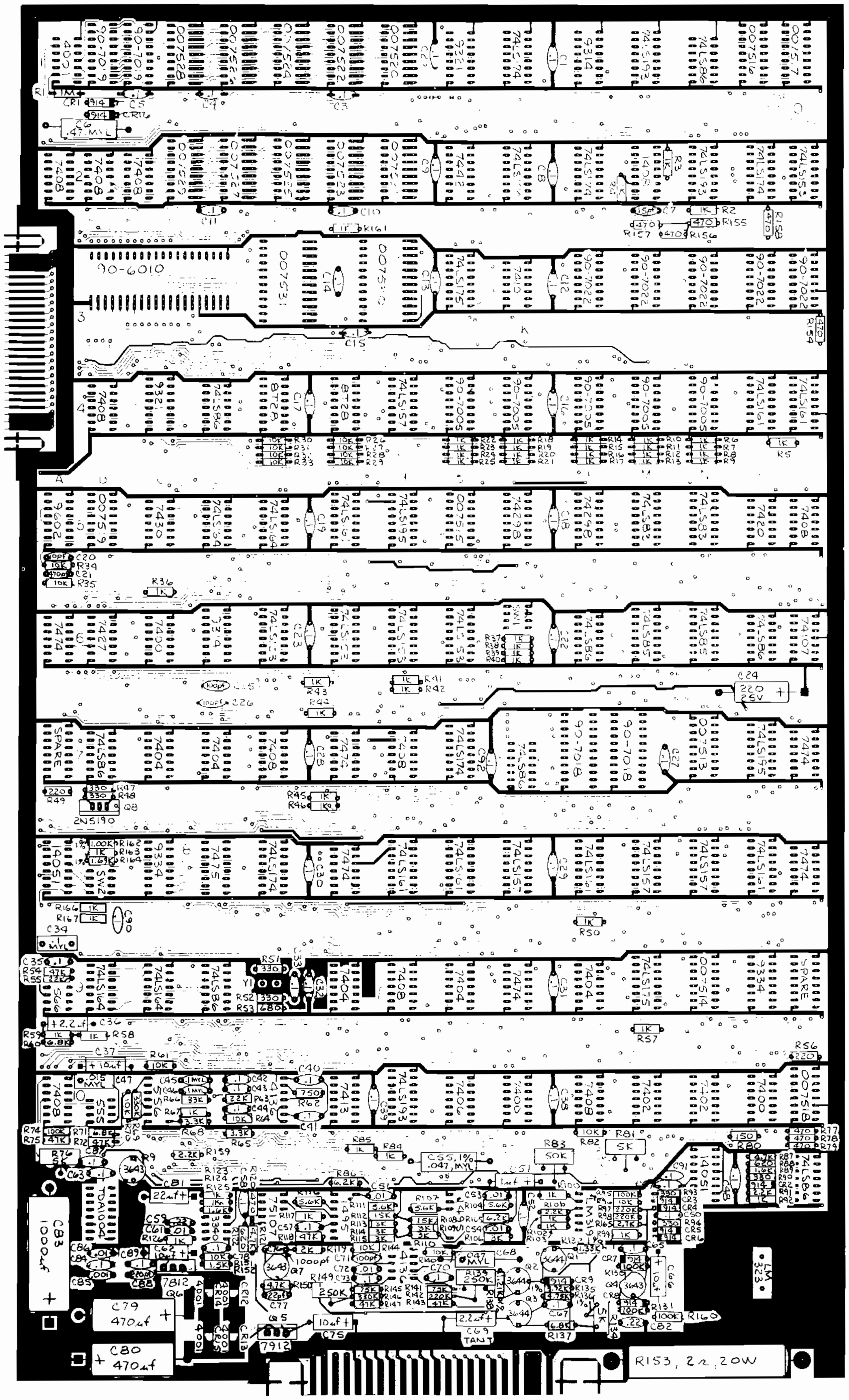


Figure 20 Starship 1 PCB SChematic Diagram (Sheet 3 of 3)



Starship 1™ PCB
(Sheet 1 of 3)

Item	Part Number	Qty.	Description
1	006695-01	1	P.C. Board
2	10-5151	1	Res. Car. Comp. ¼ W, 5%, 150 OHM R80
3	10-5221	2	" " " " " " 220 " R49.56
4	10-5331	7	" " " " " " 330 " R47,48,51,52,90,93,94
5	10-5471	9	" " " " " " 470 " R77-79,120, 154-158
6			
7	10-5621	2	" " " " " " 620 " R88,122
8	10-5681	1	" " " " " " 680 " R53
9	10-5751	1	" " " " " " 750 " R62
10	10-5102	55	" " " " " " 1K " R2-25,36-46,50,57-59 67,84,85,92,99,100,102, 103,117,123,124,126, 161,163,166,167
11			
12	10-5152	1	" " " " " " 1.5K " R152
13	10-5162	2	" " " " " " 1.6K " R89,125
14	10-5202	1	" " " " " " 2K " R119
15	10-5222	3	" " " " " " 2.2K " R91,101,159
16	10-5302	6	" " " " " " 3K " R106,109,110,113-115
17	10-5332	2	" " " " " " 3.3K " R65,68
18	10-5472	3	" " " " " " 4.7K " R87,121,150

Item	Part Number	Qty.	Description
19	10-5562	4	Res, Car. Comp. ¼ W 5%, 5.6K OHM R104,107,111,116
20	10-5622	2	" " " " " 6.2K " R86,105
21	10-5682	3	" " " " " 6.8K " R71,137,60
22	10-5103	18	" " " " " 10K " R26-35,61,64,70, 82,96,140,144,151
23	10-5153	2	" " " " " 15K " R108,112
24	10-5223	2	" " " " " 22K " R55,63
25	10-5333	1	" " " " " 33K " R66
26	10-5473	6	" " " " " 47K " R54,72,75,118,143, 147
27	10-5753	2	" " " " " 75K " R141,145
28	10-5104	5	" " " " " 100K " R74,95, 130,131, 160
29	10-5224	3	" " " " " 220K " R97,98,142
30	10-5334	2	" " " " " 330K " R69,146
31	10-5105	1	Res, Car. Comp. ¼ W 5% 1M OHM R1
32	14-1472	1	" " Film " 1% 4.75K OHM R136
33	14-1392	1	" " " " " 3.92K " R135
34	14-1122	1	" " " " " 1.21K " R138
35	14-1132	1	" " " " " 1.33K " R132
36	19-8D9W2P0	1	Res, Wirewound 2 OHM, 20 W R153
37			
38	19-315502	3	Trimpot, 5K OHM R76,81, 134
39	19-315503	1	" 50K OHM R83
40	19-315254	2	" 250K OHM R139,149
41	21-101473	1	Cap, Mylar, .047uf 100V C68
42	21-101153	1	Cap, Mylar, .015uf 100V C47
43	21-101104	3	Cap, Mylar, .1 uf 100V C34,45,46
44	21-101474	1	Cap, Mylar, .47uf 100V C6

Starship 1" PCB
(Sheet 2 of 3)

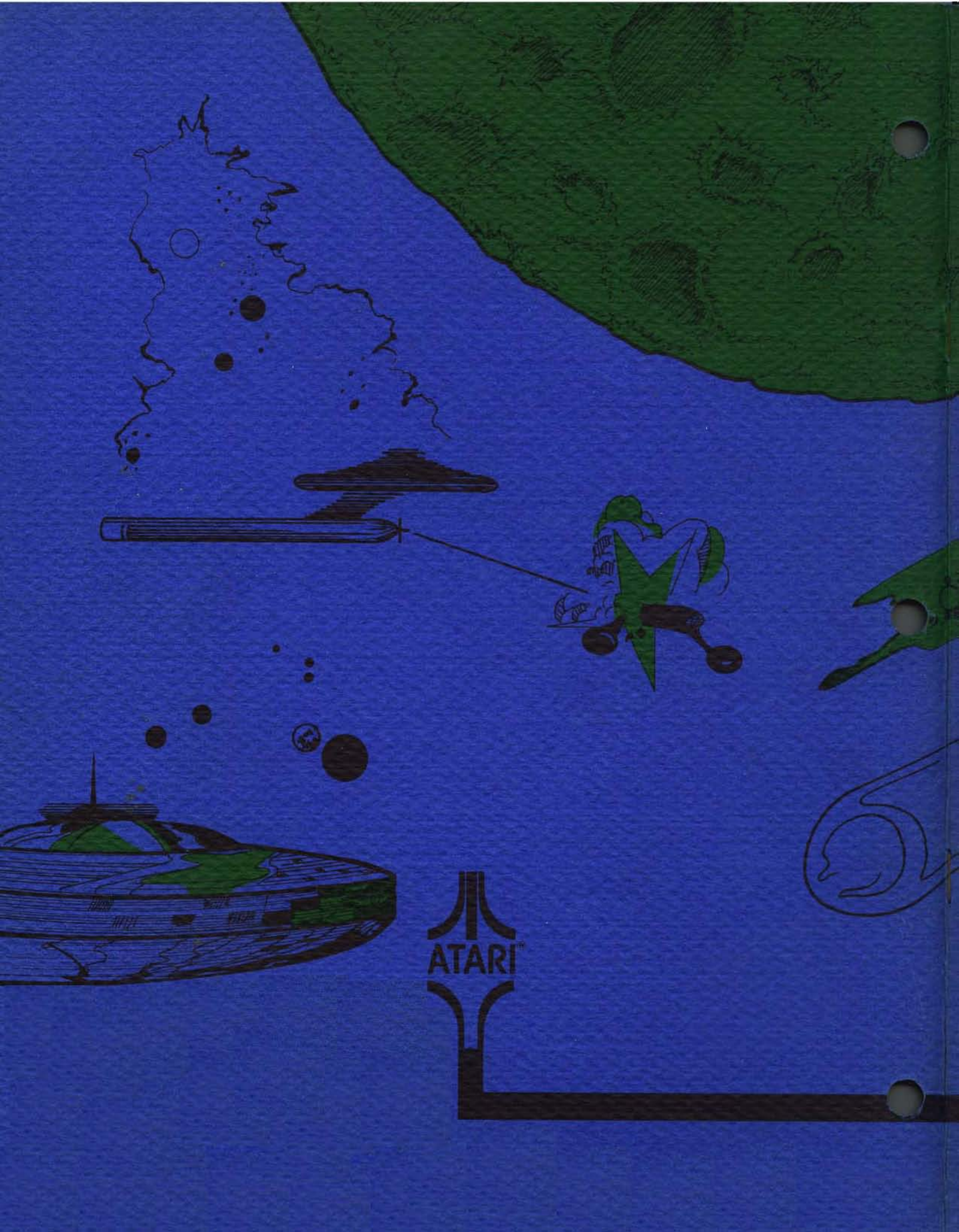
Item	Part Number	Qty.	Description	
45	24-250105	1	Cap, Elect 1uf 25V	C51
46	24-250225	1	" " 2.2uf 25V	C36
47	24-250106	4	" " 10uf 25V	C37,62,66,75
48	24-250227	1	" " 220uf 25V	C24,
49	24-250477	2	Cap, Elect 470uf 25V	C79,80
50	24-250226	1	" " 22uf "	C81
51	24-250108	1	" " 1000uf "	C83
52	27-250103	6	Cap, Cer Disc .01uf 25V	C53,54,56,61,72,86
53	27-250104	52	" " " 0.1uf 25V	C1-5,8-19,22,23,27-33,35,38-44,48-50, 52,57,58,63,65,67, 70,73,78,84,87,89, 90,91,92
54	27-250224	1	Cap, Cer Disc .22uf 25V	C59
55	27-250102	1	" " " .001uf "	C85
56	28-101100	1	Cap, Dipped Mica 10pf 100V	C20
57	28-101150	1	" " " 15pf 100V	C7
58	28-101220	1	" " " 22pf 100V	C77
59	28-101101	3	" " " 100pf 100V	C25,26,71
60	28-101471	1	" " " 470pf 100V	C21
61	28-101102	1	" " " 1000pf 100V	C76
62	28-101221	1	" " " 220pf 100V	C88
63	29-010	1	Cap, Tantalum 2.2uf 10V	C69
64	29-063	1	Cap, Polycarbon, .047uf,50V,1%	C55
65				
66	31-1N914	10	Diode, 1N914	CR1-9,16
67	31-1N4001	4	Diode, 1N4001	CR12-15
68				
69	33-2N3644	3	Transistor, 2N3644	Q1-3
70	34-2N3643	3	Transistor, 2N3643	Q4,7,9

Item	Part Number	Qty.	Description	
71	34-2N5190	1	Transistor, 2N5190	Q8
72				
73	37-7400	3	I.C. 7400	C6,K10,P10
74	37-7402	2	I.C. 7402	M10,N10
75	37-7404	5	" 7404	C7,D7,F9,J9,L9
76	37-7406	1	" 7406	J10
77	37-7408	10	" 7408	A2,B2,C2,B4,R5,E7, H7,H9,A10,L10
78	37-7410	1	" 7410	K3
79	37-7413	1	" 7413	F10
80	37-7420	1	" 7420	P5
81	37-7427	1	" 7427	B6
82	37-7430	1	" 7430	C5
83	37-7442	1	" 7442	J2
84	37-7474	6	" 7474	A6,F7,R7,F8,R8,K9
85	37-74LS83	2	" 74LS83	M5,N5
86	37-74LS85	2	" 74LS85	M6,N6
87	37-74LS86	8	" 74LS86	N1,D4,L6,P6,D9,R11 B7,K7
88	37-74107	1	" 74107	F6
89	37-74LS153	5	" 74LS153	R2,E6,F6,H6,J6
90	37-74LS157	4	" 74LS157	H4,K8,M8,N8
91	37-74LS161	7	" 74LS161	P4,R4,F5,H8,J8,L8, P8
92	37-74LS164	4	" 74LS164	D5,E5,B9,C9
93	37-74LS174	6	" 74LS174	K1,K2,L2,P2,J7,E8
94	37-74LS175	2	" 74LS175	J3, M9
95	37-74LS193	3	" 74LS193	M1,N2,H10
96	37-74LS195	2	" 74LS195	H5,P7
97	37-74298	2	" 74298	K5,L5

Item	Part Number	Qty.	Description	
98	37-555	1	I.C. 555	B10
99	37-556	1	" 556	C10
100	37-566	1	" 566	A9
101	37-1408	1	" 1408	M2
102	37-1495	2	" 1495	F11,J11
103	37-75107	1	" 75107	E11
104	37-9314	2	" 9314	L1,D6
105	37-9321	2	" 9321	J1,C4
106	37-9334	2	" 9334	C8,P9
107	37-9602	1	" 9602	A5
108	37-4001	1	" 4001	A1
109	37-8T28	2	" 8T28	E4,F4
110	37-LM319	1	" LM319	L11
111	37-TDA1004	1	OP. AMP TDA1004	B11
112	37-14051	2	I.C. 14051	A8,N11
113	37-4136	2	" 4136	E10,H12
114	37- MC3340P	1	" MC3340P	D11
115	37-LM323	1	Regulator LM323	
116	37-7812	1	Regulator +12V 7812	Q6
117	37-7912	1	Regulator -12V 7912	Q5
118	37-7475	1	I.C. 7475	D8
119				
120	90-6010	1	I.C.	C3
121	90-7005	5	RAM, 82S25	J4,K4,L4,M4,N4
122	90- 7022	5	RAM, 82S17	L3,M3,N3,P3,R3
123	90-7018	2	RAM, 2101A-2	M7,L7
124	90-7019	2	RAM, 2111A-4	B1,C1
125				

Item	Part Number	Qty.	Description	
126	66-114P1T	2	Dipswitch, 4PST (SW1) (SW 2)	K6, B8
127	90-102	1	Crystal, 12.096 MHZ	Y1
128	79-42040	1	Socket, 40 Pin	C3
129	78-06022	1	Heatsink, TDA1004	
130	78-16005	1	Silpad	
131	72-1608C	2	Screw, Mach., Pan Hd. Phil #6-32 x ½ Cres	
132	75-016S	2	Washer, Flat #6	
133	75-056	2	Washer, Lock, Int Star #6	
134	75-916C	2	Nut, Hex, #6-32 Cres	
135	78-13016	A/R	Cement, TDA1004 Heatsink	
136	007513-01	1	Prom, Alpha-Numerics	N7
137	007514-01	1	" Sync	N9
138	007515-01	1	" Object	J5
139	007516-01	1	" Spaceship Z2	P1
140	007517-01	1	" Spaceship Z1	R1
141	007518-01	1	" Video Output	R10
142	007519-01	1	" Address	B5
143				
144	007530-02	1	Program Rom 3000	H3
145	007531-02	1	Program Rom 3800	E3
146	007528-02	1	Prom, Program 2C00-0	C/D1
147	007529-02	1	Prom, Program 2C00-1	C/D2
148	10-5272	1	Res, Carbon, ¼W, 5%, 2.7k Ohm	R165
149				
150	14-1102	1	Res, Film, ¼W, 1%, 1.00K Ohm	R162
151	14-1162	1	" " " " 1.69K Ohm	R164

**Starship 1™ PCB
(Sheet 3 of 3)**


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